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A McGRAW-HILL PUBLICATION

NOVEMBER 27, 1947

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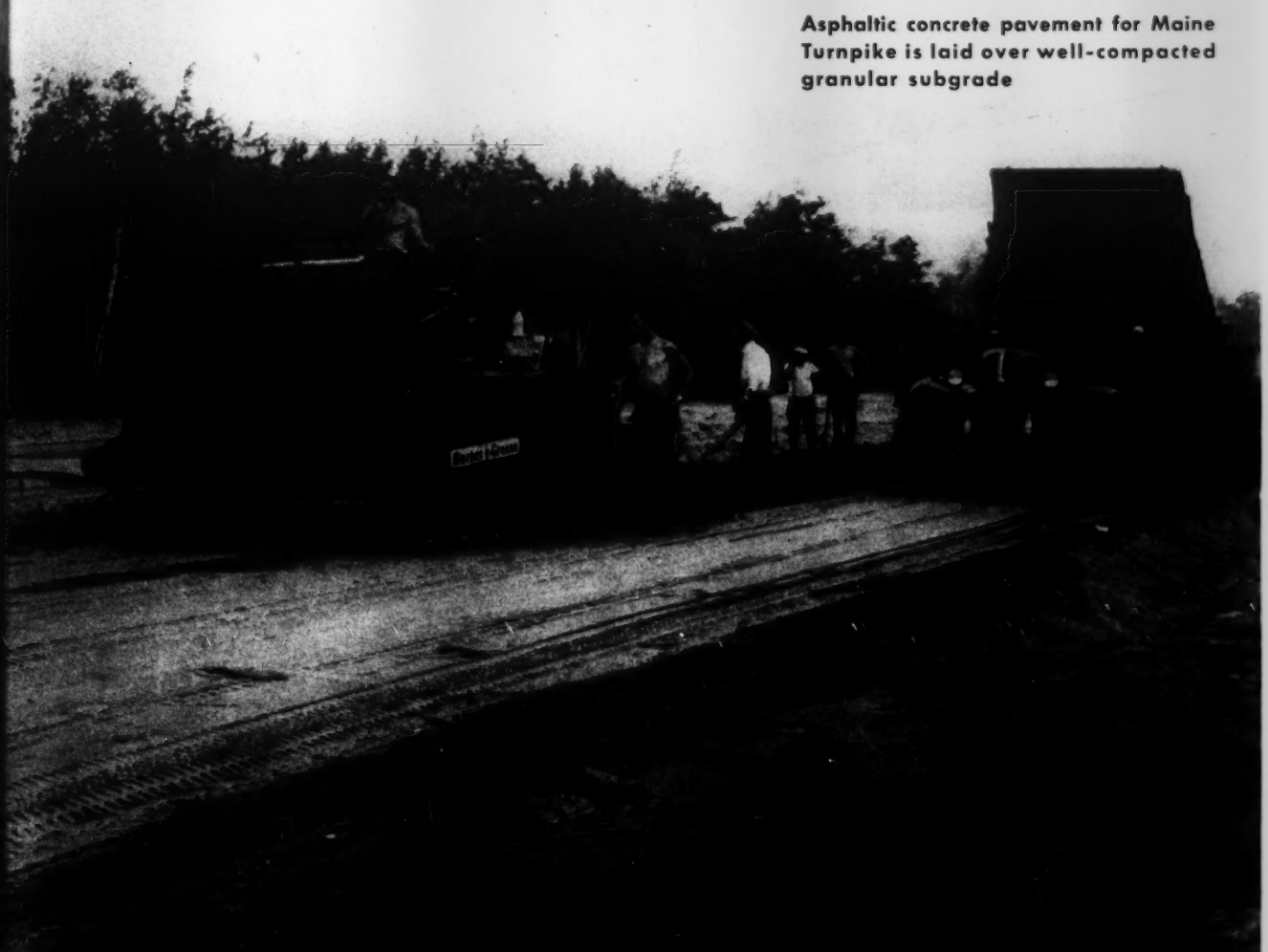


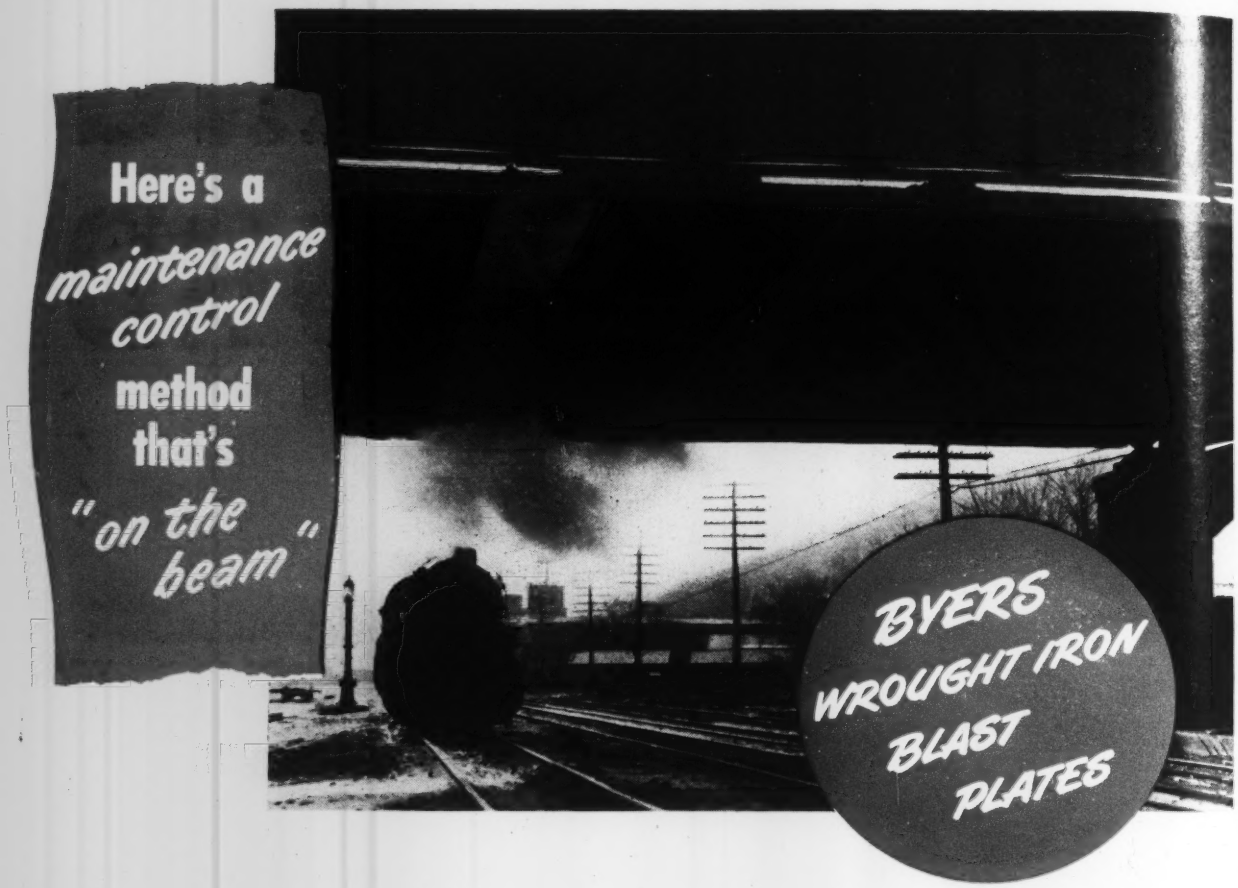
Asphaltic concrete pavement for Maine Turnpike is laid over well-compacted granular subgrade

INCLUDING ARTICLES ON

FINDING LIMITS FOR SEWAGE DILUTION

TESTING A 40-YEAR-OLD CONCRETE DAM

TRACK RELOCATION FOR FASTER TRAINS



Bridges that overpass railroad tracks generally take more of a beating from locomotive blast gases than from the vehicular traffic they carry. The bridge engineers of the Cincinnati Highway Department recognized this fact . . . and took steps to protect their Beechmont Avenue concrete structure in a time-tested way. They installed wrought iron blast plates, fabricated by Littleford Bros., Inc., to shield the bridge beams from attack and so avoid excessive maintenance.

The importance of this protection is obvious when conditions are analyzed. The smoke contains moisture, and carbon and sulfur compounds, which combine to form aggressive acids. The ash and cinder that are expelled at high velocity have an abrasive, "sand-blasting" action that grinds away at the surface of the bridge members. Finally, the blast causes extreme variations of temperature. All this results in a rapid reduction of section, whether the members are concrete or metal, and to ultimate extensive repairs. Wrought iron is almost universally used for protection, for its unusual resistance to corrosion from blast gases has been demonstrated conclusively over periods of many years. The most impressive evidence is found in the service records of old wrought iron bridges, which were exposed to blast gases for decades with no ill effects.

The reason that Byers Wrought Iron serves so well in this punishing application is found in its unusual structure and composition. Tiny fibers of glass-like silicate slag, threaded through the body of high-purity iron, halt and disperse corrosive attack, and so discourage local pitting. The fibers also help to anchor the initial protective scale, which shields the underlying metal.

You will find some helpful information on the use of wrought iron for blast plates in our bulletin, "Wrought Iron in Bridge Construction." Ask for a copy.

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Volume 139 • Number 22

NOVEMBER 27, 1947

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THE COLORADO - BIG THOMPSON JOB

Nine years have elapsed since construction was initiated on Colorado's great trans-mountain diversion scheme for bringing additional irrigation water through the Continental Divide. Another five years must pass before the project goes into full operation. What is being accomplished and what remains to be done on this vast project of the U. S. Bureau of Reclamation will be told in a forthcoming issue.

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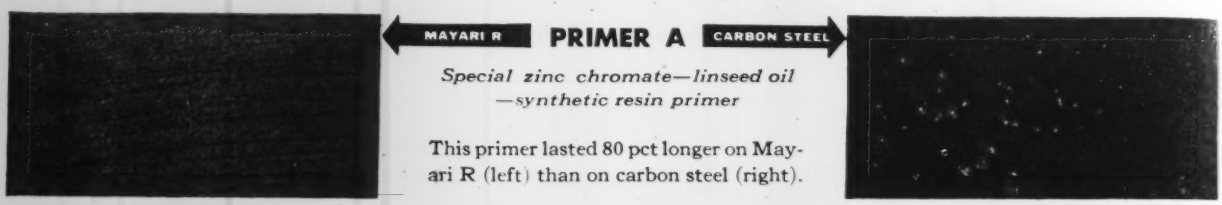
Tests show MAYARI R holds paint 20% to 80% longer

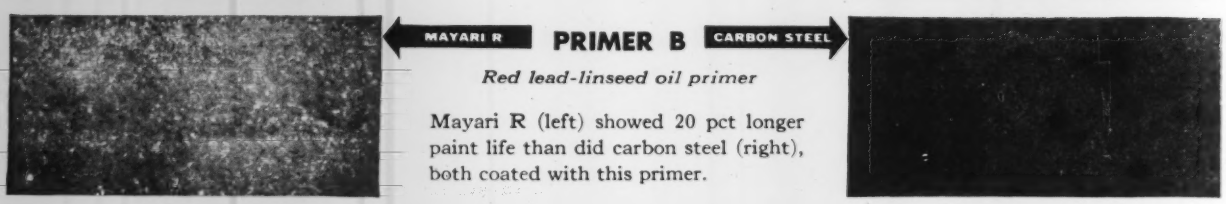
On December 22, 1944 a test was started to determine the relative paint adherence of Mayari R steel and ordinary carbon steel. Five specimens of each of these steels in 4-in. by 4-in. by ¼-in. angle sections with typical partly rusted scale surfaces were wire brushed and given a coating of each of five different types of primer paint at a uniform dry film thickness of 2.5 mils. These painted sections were then placed at a 45-degree angle in a corrosive industrial atmosphere. After exposure under identical conditions for the same period of time, adherence results were as shown below.



PRIMER A

Special zinc chromate—linseed oil —synthetic resin primer

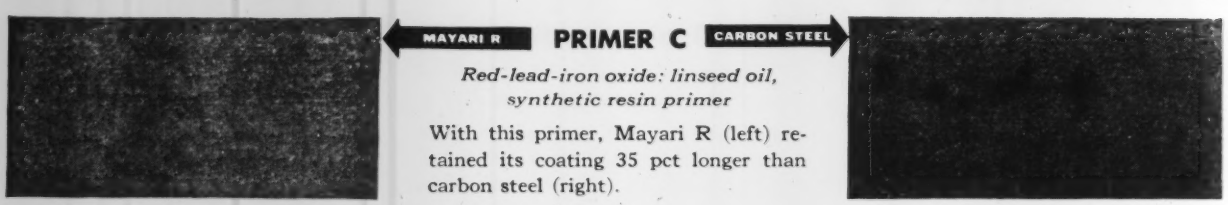
This primer lasted 80 pct longer on Mayari R (left) than on carbon steel (right).



PRIMER B

Red lead-linseed oil primer

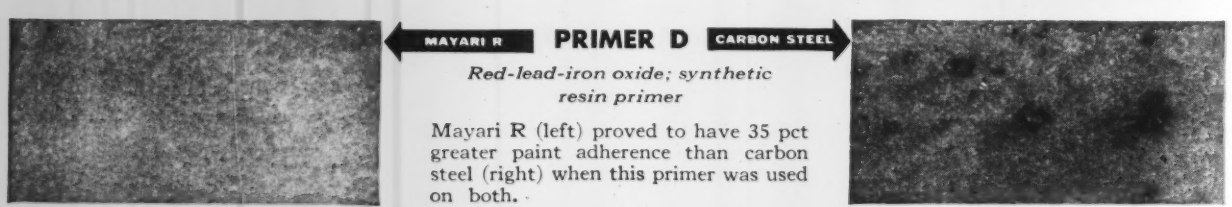
Mayari R (left) showed 20 pct longer paint life than did carbon steel (right), both coated with this primer.



PRIMER C

Red-lead-iron oxide: linseed oil, synthetic resin primer

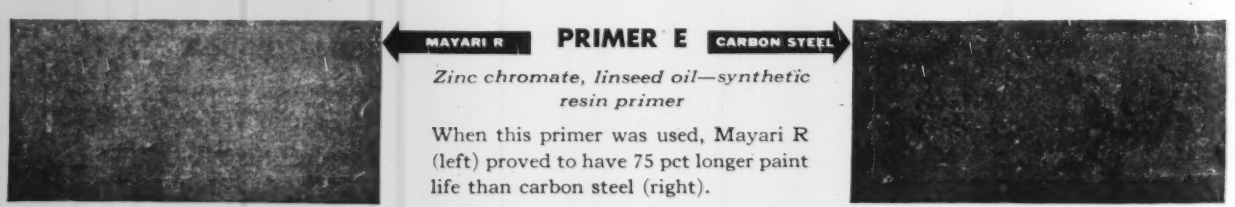
With this primer, Mayari R (left) retained its coating 35 pct longer than carbon steel (right).



PRIMER D

Red-lead-iron oxide; synthetic resin primer

Mayari R (left) proved to have 35 pct greater paint adherence than carbon steel (right) when this primer was used on both.



PRIMER E

Zinc chromate, linseed oil—synthetic resin primer

When this primer was used, Mayari R (left) proved to have 75 pct longer paint life than carbon steel (right).

This research investigation, confirmed by the experience of Mayari R users in many industrial applications, shows how important savings in paint and labor are made possible through the use of Mayari R low-alloy, high-tensile, corrosion-resisting steel.

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Construction Trends

New Peacetime High Recorded by Public Building

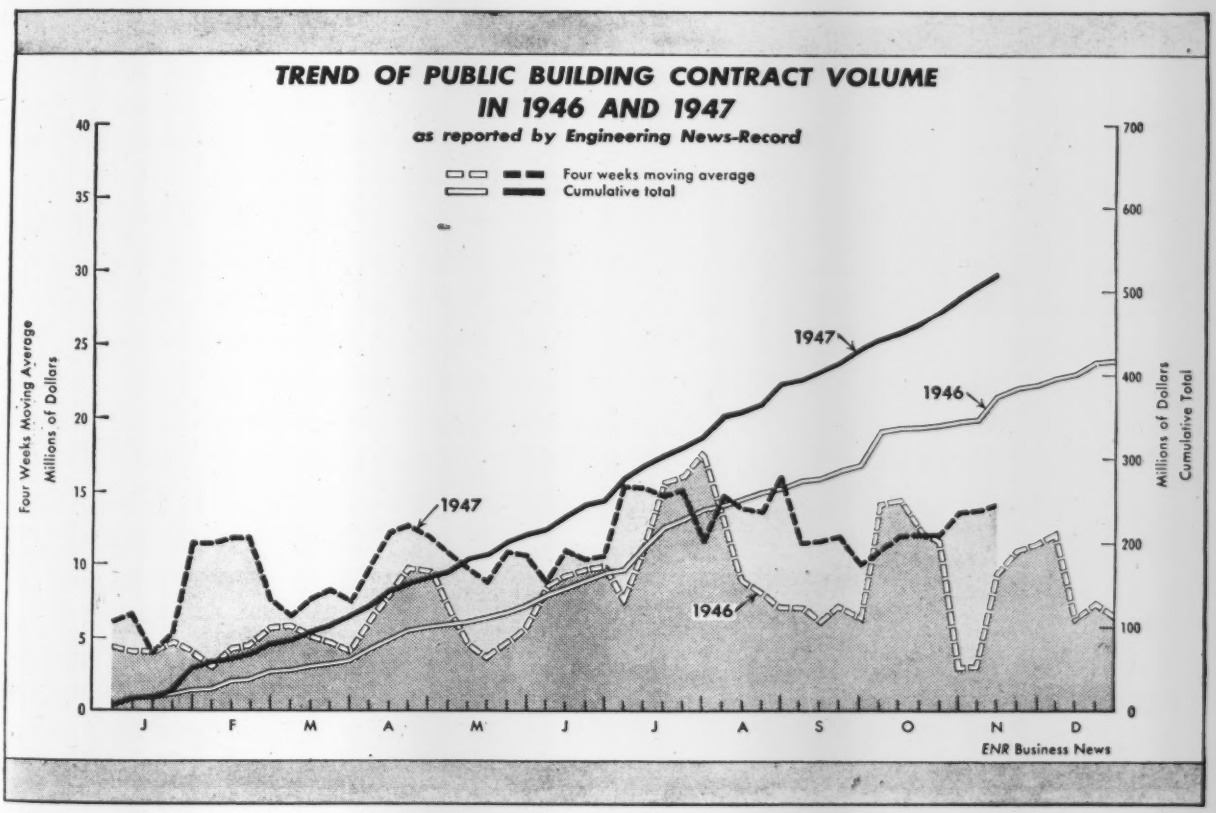
The cumulative total of public contract awards, as reported by *Engineering News-Record*, amounts to $519,874,000 for the first 46 weeks of 1947 as compared with $374,924,000 in the corresponding period of 1946, a gain of 39 percent. The contract volume recorded so far this year is higher than the volume for the corresponding period of any full peacetime year on record.

The four weeks moving average of the dollar volume of public building contracts of $14,118,000 for the second week of November is running 51 percent above the average for mid-November, 1946. If the rate of contract awards during the remainder of 1947 is maintained close to current highs, total public building contracts for the year should amount to approximately $580,000,000. This would represent a rise of 40 percent over the 1946 volume of $414,087,000 and a rise of 25 percent over the 1945 volume of $462,909,000.

Public building construction reached unprecedented peaks during the war years, rising to a record high of $5,678,000,000 in 1942. Three other years during this period were also billion-dollar years. Contract awards amounted to $1,196,000,000 in 1940, to $2,786,000,000 in 1941 and to $1,419,000,000 in 1943.

The backlog of needed construction in the field of public building is $8,267,177,000 based on 1940, 1943, 1944, 1945, 1946 and 1947 costs and values. At the 1947 rate of contract awards, the backlog alone would provide for over 13 years of public building activity. Since less than 15 percent of total contracts awarded during the year were taken from the backlog, this measure of needed construction is a conservative figure.

Approximately $414,855,000 has been made available through the middle of November, 1947 for the construction of public buildings through the sale of state and municipal bonds. This amount represents nearly 40 percent of the total state and municipal bonds of $1,047,783,000 sold so far this year. Public buildings include such structures as schools and colleges, public housing, public hospitals, court houses and other buildings financed by public funds.



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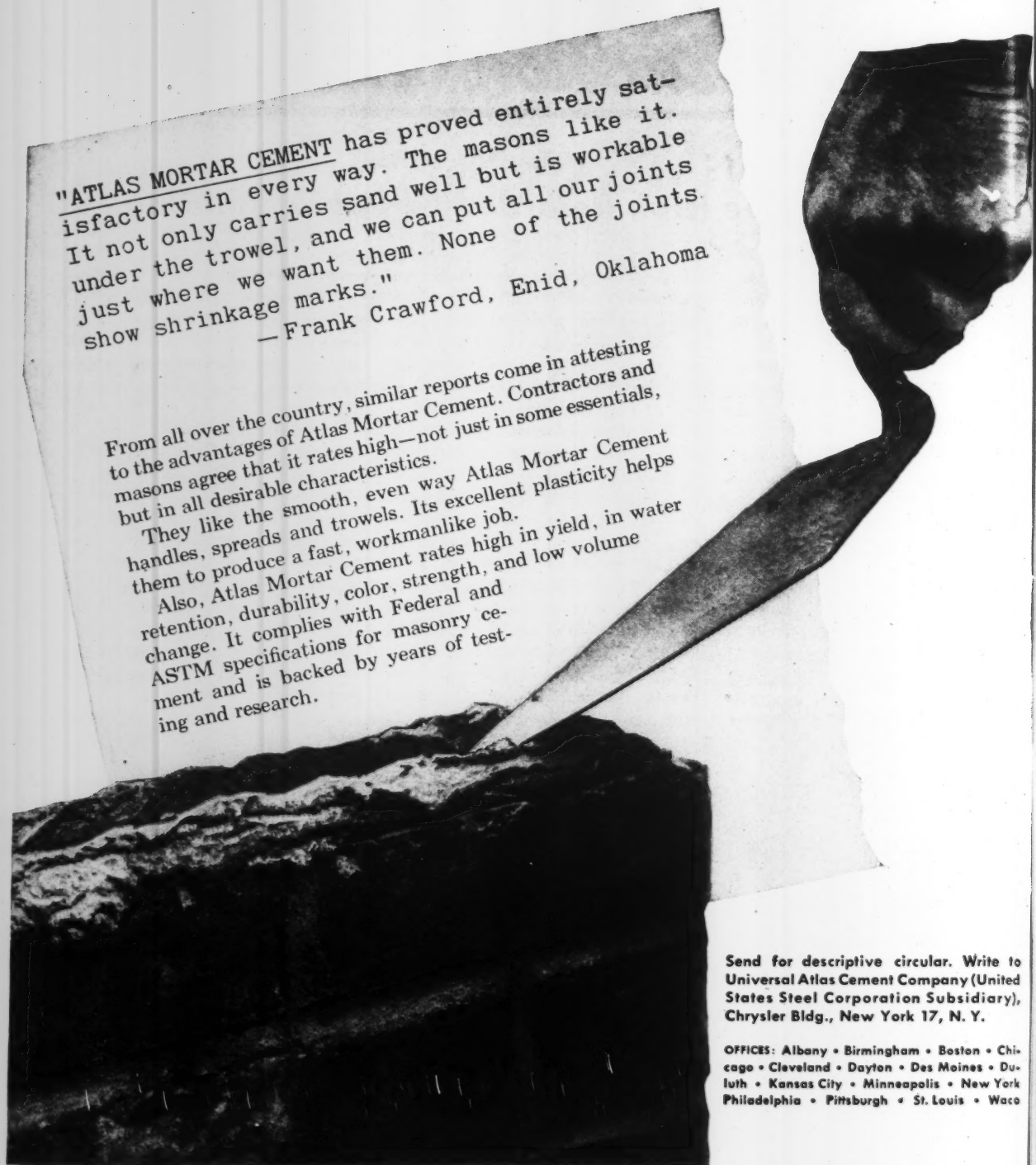
—Frank Crawford, Enid, Oklahoma

From all over the country, similar reports come in attesting to the advantages of Atlas Mortar Cement. Contractors and masons agree that it rates high—not just in some essentials, but in all desirable characteristics.

They like the smooth, even way Atlas Mortar Cement handles, spreads and trowels. Its excellent plasticity helps them to produce a fast, workmanlike job.

Also, Atlas Mortar Cement rates high in yield, in water retention, durability, color, strength, and low volume change. It complies with Federal and ASTM specifications for masonry cement and is backed by years of testing and research.



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News of the Week

ENGINEERING NEWS-RECORD • NOVEMBER 27, 1947 • VOLUME 139 • NUMBER 22

Building cost rise not ended, advisory council hears

Construction Industry Advisory Council told that continuing labor and materials shortages are principal factors forcing a continuing upward trend

Construction costs have not reached their peak, and as a result the volume of construction work in 1948 will not be "appreciably" greater than 1947, members of the Construction Industry Advisory Council were told last week.

Meeting in Washington, D. C., under the auspices of the U. S. Chamber of Commerce, the 125 representatives of the construction industry were given a somewhat gloomy picture of prospects for the coming year by a list of expert speakers.

The most pessimistic view was expressed by Thomas S. Holden, president of the F. W. Dodge Corp., who saw only a 9 percent increase in non-residential building, and only 4 percent for residential construction, on a dollar-volume basis. Mr. Holden predicted that this low increase would hold true despite an expected jump in the construction of apartment buildings, hotels and other rental properties. He added that contracts for heavy construction will climb only about 7 percent.

[*An increase of from 5 to 25 percent in dollar-volume of heavy construction in 1948 was estimated by the statistical department of this journal, in its issue of Oct. 30, vol. p. 571*].

Mr. Holden's final conclusion was that the physical volume of new construction started in 1948 would only equal that of this year, and he warned that an inflationary construction boom next year might be a serious setback to the industry.

Shortages seen cause

Shortages — particularly that of skilled men—were seen by many speakers as the principal factor pushing construction costs upward.

Robert W. McChesney, president of the National Electrical Contractors Association, urged more apprentice training as a means of holding down costs. "In the long run," he said, "construction can exert its most powerful downward pressure on costs by investing heavily in the training of skilled men and in technical research. Construction offers real opportunities to aggressive young men, and we must see to it that they are trained to take advantage of them."

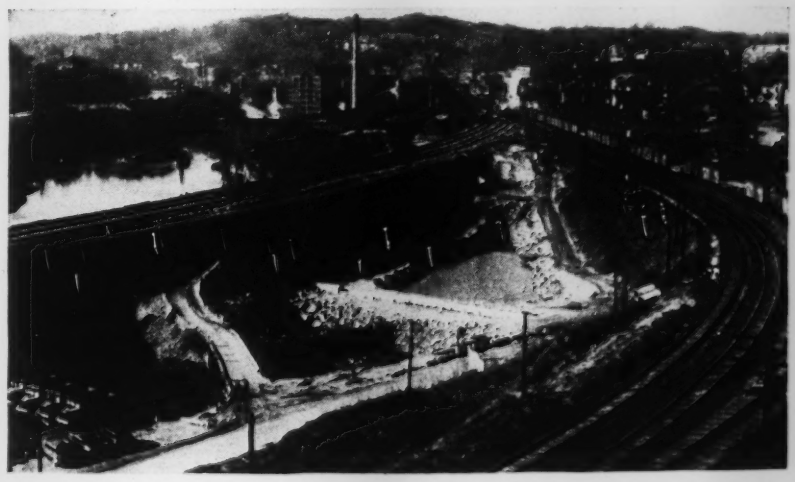
As other measures to aid the industry, Mr. McChesney urged the adoption of public education programs, greater study within the industry to determine the volume of different types of work, and modernization of building codes.

M. M. Hanson, assistant director of the Apprentice Training Service, Department of Labor, followed McChesney with a dark report on the present training programs. He told his listeners that the entire industry today is training only about 104,000 apprentices of all types. "At least 200,000 additional men should be getting the benefits of this program, if the industry is going to play the role expected of it," he said. "Long lists of veterans have applied in all the skills, but too few contractors and local groups have offered to help. Many contractors—especially those in smaller cities, must be brought into the work."

On the subject of labor, the group gave considerable attention to means for increasing labor productivity, concentrating on the need for joint action by management and labor.

Carl B. Jansen, president of the Dravo Corporation, told the group that better planning and scheduling of materials, better supervision, and cessation of job shutdowns are a means toward increasing efficiency of labor. "But it is not proper," he declared, "that either side should give all or take all. Relations between management and labor in the industry are human relations. Man-

(*Continued on page 39*)



***Curve Flattened**—Scene of one of the country's worst train wrecks (in April, 1940), a 7-degree curve in the New York Central Railroad's main line tracks at Little Falls, N. Y., has been eliminated by construction of a new roadbed (at left) that involved changing the course of the Mohawk River at that point. The old roadbed at right will be abandoned. Walsh Construction Co., Davenport, Ia., was contractor (ENR Jan. 16, vol. p. 88).*

NEWS IN BRIEF

In telegraphic form, here are latest news developments on the engineering and construction front during the week.

Construction — Victor Chemical Works has let contract for a $1,500,000 processing plant at *Morrisville, Pa.* . . . International Paper Co., *New York*, has announced a $25,000,000 expansion program . . . Penn Center Co. of *Philadelphia, Pa.*, has awarded a $2,500,000 contract for a building to house a sports arena . . . Mississippi River Fuel Corp. is seeking permission to build a $13,654,000 natural gas pipeline from *Monroe, La.*, to *St. Louis, Mo.* . . . Plans have been prepared for a $2,000,000 Southwestern Legal Center at the Southern Methodist University, *Dallas, Tex.* . . . A million dollar plant for the Southern Acid and Sulphur Co. has been completed at *North Little Rock, Ark.* . . . Foundation work on the $1,000,000 plant of the Gulf Chemical Co. at *Houston, Tex.*, will begin at once . . . A tuberculosis sanitarium to cost $750,000 is to be started soon at *Edmonton, Alta.* . . . A contract for $1,000,000 worth of additions to the general administration building of the Armstrong Cork Co. at *Lancaster, Pa.*, has been awarded to Herman Wohlsen's Sons of that city . . . John Wanamaker will build a $1,000,000 department store at *Wilmington, Del.*

Housing—In the Santa Rosa addition, *Houston, Tex.*, 130 houses to cost $1,300,000 will be built . . . Woodfields, a $2,700,000 planned community of over 300 homes is being developed on a 165-acre tract a few miles from *Greenville, S. C.* . . . A $6,000,000 apartment project to provide homes for 504 families is under way in *Atlanta, Ga.* Southeastern Construction Co., of *Charlotte, N. C.*, has the contract for the Lindmont and Morosgo apartments, situated in 85 separate 2-story brick and tile buildings on a 30-acre tract . . . A $3,500,000 garden-type rental housing project is being planned at *Camp Hill, Pa.*, suburb of *Harrisburg*, by the Mutual Life Insurance Co. . . . Plans for a 636-unit apartment development at *Bellevue*, north of *Wilmington, Del.*, at a cost of over $6,000,000 have been revealed.

Highways — *Tennessee* has programmed $7,000,000 of $11,000,000 in federal funds available for secondary roads . . . The 1948 road building program of the *Province of Alberta* will call for at least $13,000,000 . . . The *Milwaukee, Wis.*, common council has approved the construction of an expressway system and feeders to cost many millions of dollars . . . The highway commission of *Texas* is opening bids on about $5,000,000 worth of projects . . . The Farm Bureau of Mississippi has voted to ask the legislature to provide for an experimental 2-year $15,000,000 rural road program, half the funds to be appropriated by the legislature and the other half to be raised through increasing the state gasoline tax one cent.

Water supply and sewerage—On Dec. 2, *Dallas, Tex.* will vote on a $11,000,000 water department revenue bond issue. If passed, the bond issue will be used to supply funds to build 24 sanitary sewer improvement projects and 35 water line expansion projects during the next two years. . . . The sewage treatment plant of *Toronto, Ont.*, under construction since 1944, is to be a primary treatment plant initially and will be extended to give complete treatment by activated sludge process four years after operation starts.

Miscellany—*Tennessee* is to begin a state armory construction program. The armories may be built underground, according to Adj. Gen. Hilton Butler . . . *Lancaster, Pa.*, voters rejected a $2,000,000 bond issue for a war memorial community center . . . The first federal land condemnation suit, involving 890 acres, for the $12,000,000 Lavon Dam project to be built at *Lavon, Tex.*, was filed recently at Sherman in the U. S. District Court . . . The Great Northern Railway Co. has announced it will relocate a 4.6-mi. section of track on the east slope of the Cascade Mountains in Washington at an estimated cost of $1,000,000 . . . A low bid of $1,968,267 has been received by the Broome County Board of Supervisors for constructing the first phase of the $4,717,450 Broome County Airport at *Mt. Ettrick, N. Y.* . . . Bureau of Reclamation has chosen a site for the Culbertson Dam on the Republican River 2½ miles from *Trenton, Neb.*

***Launch Steel Research**—Principals in the announcement of a $100,000 research program at the recent Miami Beach, Fla. convention of the American Institute of Steel Construction (ENR Nov. 20, vol. p. 706). Left to right are Jack Singleton, chief engineer for the AISC; Herman Lind, president, American Institute of Bolt, Nut and Rivet Manufacturers; N. R. Patterson, first vice-president, AISC, and T. R. Higgins, AISC engineering director. The research program, to be carried out jointly with the PRA, Illinois Highway Division, Association of American Railroads, the Engineering Foundation and Mr. Lind's organization, will study characteristics of rivets and other fasteners in steel structural work.*

Chicago Bridge & Iron Co. to build at Salt Lake City

The Chicago Bridge and Iron Co. has announced plans to start immediate construction on a fabricating plant in Salt Lake City, Utah.

The announcement was made by E. E. Michaels, Chicago, vice-president of operations, who revealed that the company was attracted to the Salt Lake area by the steel supply which will be available from the Geneva steel plant.

Site of the plant will be in the city's west-end industrial area.

Urge 1,500,000 home-building rate

Governmental encouragement of the private housing industry to enable it to reach an annual rate of 1,500,000 new home units was urged last week as the answer to the United States' continuing housing shortage.

The recommendation, contained in a report of a joint committee, was an outstanding feature of a 4-day convention of the National Association of Housing Officials held in New York City. The committee represented the NAHO and the National Public Housing Conference, joint meetings.

Committeemen, noting that the 1,500,000 rate would mean virtually doubling this year's rate of home construction, called for bi-partisan action in the Congress to pass such measures as the much-debated Taft-Ellender-Wagner Housing Bill as a means of encouraging private construction and extending public housing programs. The group also called for analyses by state and national housing agencies to determine the needs of such a tremendously expanded program.

The report stressed the difficulties of the low and middle-income groups of Americans, who have been unable to meet current inflated home prices.

Stressing the same problem—that of the lower income-bracket family—President Harry S. Truman, in a message read to the meeting, urged the adoption of a "broad, energetic" program to stimulate private housing.

"We now need a broader attack on slums, urban and rural," the President said. "We need energetic action by government at all levels. . . . We need determined action by private enterprise to reduce costs."

The nation must treat the housing problem as something more than a recurring emergency, the President added, and bring about basic, enduring improvements.

Following the same keynote theme, Raymond M. Foley, Federal Housing and Home Finance Administrator, urged that public and private housing interests combine to eliminate prejudices and to exchange information and experience. Mr. Foley warned that public housing is not a sole panacea for the housing shortage.

The group elected Ray O. Edwards, executive director of the Jacksonville, Fla., Housing Authority, as president.

Building cost rise not yet at peak

(*Continued from page* 37)

agement should seek to know its employees and understand their problems. A just and adequate wage should be paid for honest and conscientious effort, and that is generally being done at the present time as a result of bona fide collective bargaining. Management itself must be efficient if high production is expected from labor."

Richard Gray, president of the Building Trades Department of the American Federation of Labor, also called for realization of joint management-labor responsibility. Admitting that labor had not been "too productive" over the last few years, Gray said that the problem cannot be dealt with merely on the basis of conditions at the site. "Disruptive forces are at work elsewhere as the result of inflation," he said. "No one can deny that speculative resale of existing buildings at highly inflated prices has contributed greatly to the inflation in price of new buildings. There is evidence also that high financing charges have frequently reached the proportions of outright sabotage of the building market."

Discuss European aid

Discussion of the proposed program of aid to European nations disclosed that the industry is uncertain of the effect of the program at home. Government representatives said that estimates by the various construction agencies vary widely as to the domestic effect of the foreign aid program.

C. H. H. Weikel, manager of commercial research for the Bethlehem Steel Co., said that U. S. industry may get 3,500,000 tons less steel in 1948 if the European aid program is adopted.

Other discussions at the meeting included: legal means of gaining adoption of better building codes; and a report on the findings to date of Congressional committees investigating the industry.

Just before the closing session, steps were taken to advance the research program to be carried out by the Building Research Advisory Board established as part of the National Research Council last year (*ENR* Nov. 28, 1946, vol. p. 699). Frank B. Jewett, recently appointed chairman of the board, said the first task would be setting up machinery to assemble and distribute research data already acquired by many groups in the industry. A drive was started for the collection of $100,000 during each of the next five years to finance the board's activities.

Shreveport VA hospital contracts are awarded

Contracts for the 250-bed General Medical Hospital being built by the Corps of Engineers for the Veterans Administration at Shreveport, La., were awarded Nov. 17 by the New Orleans District of the Army Engineers.

J. W. Bateson, Dallas, Tex., got the general contract with a bid of $6,920,080, while the electrical work went to the S. H. Electric Co., Shreveport, at $489,968, and installation of the elevators to the Otis Elevator Co., Dallas, Tex., at $292,600. The mechanical work has not yet been awarded.

Max A. Berns dies, was portland cement advocate

Max A. Berns, a civil engineer who had devoted much of his active career to the promotion of the use of portland cement as publicity manager of the Universal Atlas Cement Co. since 1920, died Nov. 19 in New Rochelle, N. Y.

Mr. Berns received a B. S. degree in civil engineering at the University of Illinois in 1910. During the next three years he taught mathematics and mechanical drawing in the East Technical High School, Cleveland, Ohio. He joined the Universal Atlas in Chicago in 1913 and remained with the company thereafter, except for the final two years of the first world war in which he served with the AEF as a captain of engineers.

Tolls not the answer, says AASHO head

Toll roads are not the answer to the problem of modernizing highway systems, according to Oregon State Highway Engineer R. H. Baldock, president of the American Association of State Highway Officials. Declaring that groups sponsoring the toll road idea expect that eventually the states will take over the roads and make them toll-free, with taxpayers footing the bill, Baldock said:

"The public will be far better off in the long run if the fees and taxes upon road users are increased to shorten the time required to build the needed facilities on our state highway systems.

"Exhaustive studies made in many places indicate that, with possibly a few exceptions, it cannot be reasonably expected that traffic will bear the additional charges on toll facilities for a long enough period to amortize the investment, maintain the facilities and carry the cost of operation

HIGHLIGHTS OF MUNICIPAL DEVELOPMENTS

Chicago gets first completed draft of new building code—Los Angeles dissolves air-pollution control group—Fort Worth airport approved by CAA

A new building code for Chicago moved a step nearer realization last week when city councilmen received the first draft of the proposed document from John O. Merrill, director of code revision.

Produced at a cost of $80,000 through 13 months' work by a group of architects, engineers and builders, the new draft is actually a performance code, in sharp contrast to the specification-type code now in force. The new document sets up performance standards corresponding to recommendations of technical organizations such as the American Standards Association, the Building Officials Conference of America, the National Bureau of Standards and the National Board of Fire Underwriters.

Avoiding mention of specific materials, the code stipulates the standards to be met for such physical requirements as structural strength, fire and weather resistance. Additionally, it prescribes test procedures to be followed by the building commissioner in determining the acceptability of any material or building element. On the basis of the test results, rules and regulations governing the use of the tested materials would be written.

Largely because it is drafted on a performance basis, the new code covers the requirements in about half the length of the old one, and city officials hoped that public hearings on it could be completed in a short time.

Another concrete proposal for revising a city's code was presented last week at St. Louis, Mo., where city councilmen began consideration of a group of bills submitted at the request of the building commissioner, looking toward liberalization of the building code. The new provisions would include approval of 1-hour fire-resistant materials in dividing walls in 4-family apartments; permit use of any fireproof material for fire-doors; utilization of chutes for fire escapes, and would eliminate the requirement that the tops of ceiling joists be covered with fire resistant materials.

End smoke control unit

To give the newly established Los Angeles County Air Pollution Control District a clear field, the city of Los Angeles last week had dissolved its own air pollution control bureau.

Commenting that the city's unit, under the leadership of Harry Kunkel, has in two years eliminated about 80 percent of the city's air pollution, Mayor Fletcher Bowron said the dissolution of the group was in line with policies of cooperation with the county "for the general good."

Louis G. McCabe, director of the county organization, said he will set up a set of standards for industry and introduce a temporary permit or licensing system for potential smog offenders.

Master plan for water

Albuquerque, N. M., initiated action to set up a master plan to guide development of its municipal water system for the next ten years.

The city commission directed Acting City Manager Herbert W. Rankin to negotiate with qualified engineering firms for a contract under which the chosen firm would draw up a plan covering the city's water supply, storage and distribution program.

Decision to set up a general outline for waterworks expansion came a week after the commission had tabled action on a proposed water-rate reduction, an issue that has been argued in city politics for almost two years. A rate reduction was voted by the commission in 1946, but dropped when the incumbent commissioners were defeated in municipal elections.

Action on airports

Construction of the $11,500,000 greater Fort Worth, Tex., International airport has been approved by the Civil Aeronautics Administration, and city officials prepared to move the project into the construction stage.

Originally planned as a joint venture with the city of Dallas, the new airport will be built on the site of Midway Airport, equidistant from the two neighboring cities.

Other airport activity during the week included an announcement by Austin J. Tobin, executive director of the Port of New York Authority, who said that his bi-state organization is prepared to spend $175,000,000 on the airports it recently took over from the cities of New York, and Newark, N. J.

Expressway planning

The solution of municipal traffic problems by construction of expressways to carry major traffic through built-up areas appeared to remain in top place in municipal thinking during the week.

Milwaukee, Wis., approved a program

(*Continued on following page*)

***Airport in Service**—Passenger and freight service from the new $6,000,000 Charleston, W. Va., airport will start Dec. 3 when three major airlines begin scheduled operations. Completed early this month by the Harrison Construction Co., of Pittsburgh, Pa., the port has three runways, of 6,000 ft., 5,500 ft. and 5,000 ft., and its construction involved the conversion of a mountain-top into a plateau. Some 9,000,000 cu. yd. of earth and rock were moved to complete the work.*

for $60,000,000 worth of expressways through the city and directed planning work for them be carried forward; Kansas City, Mo. voters approved $14,000,000 in bonds to finance construction of expressways and boulevards and rehabilitation of streets; and Buffalo, N. Y., considered the report of its city engineering department that it should spend $13,000,000 to widen and strengthen some 70 viaducts and underground traffic routes.

At Toronto, Ont., meanwhile, the Civic Works Committee approved plans for two new arterial highways—one running north and south through the center of the city, and the other skirting the lakefront, to cost $9,000,000.

Minneapolis housing body

Under powers granted by the 1947 state legislature, Mayor Herbert Humphrey of Minneapolis, Minn., last week named a 5-man municipal housing commission. The group is empowered to float bonds, clear blighted areas for sale of land to private firms for housing development and to conduct a limited amount of "public housing" subject to referendum from the city's voters on each 1,000 units proposed.

City road work lags

Highway improvements in cities are lagging behind other phases of the federal-aid highway program, the National Highway Users Conference said last week.

Basing its report on new figures of the Public Roads Administration, the highway users said that only 17 percent of the federal funds available for urban improvements are now represented in contracts awarded.

The organization attributed the slow rate of progress to the greater amount of advance planning required.

PUT RAIN-MAKING ON BUSINESS BASIS

Rain, Inc., has been formed as a nonprofit corporation to get more rain for California's Santa Clara County. Directors of the corporation propose to use the same rain-making method used elsewhere, "seeding" of clouds with dry ice, and will send a commercial pilot up whenever they see "a likely looking cloud."

Officials of the association anticipate no legal difficulties from other areas jealous of their rainfall since clouds which float over the Santa Clara valley without dropping their moisture usually move out to sea.

Seek additional power for South Dakota, Canada

A recent request of South Dakota to buy power from the three public power districts in Nebraska may lead to a test case to determine the legality of such out-of-the-state sales, observers said last week.

Almost all of Nebraska's power needs are supplied by the Central Nebraska Public Power and Irrigation district of Hastings, the Platte Valley Public Power and Irrigation district of North Platte, and the Loup River Public Power district of Columbus. South Dakota has proposed that it be provided power by these districts when Nebraska demand is low. The proposal is to provide power in South Dakota when it is not needed in Nebraska.

Counsel for the state's power districts say there are no penalties now for selling power outside the state but that legal steps might be taken if the power were sold there and that a test case would result.

Power survey in British Columbia

Examination of the Nescall Basin 27 miles northeast of Ocean Falls, B. C., as a potential site for a major hydroelectric power development was undertaken recently for Pacific Mills, Ltd.

The dam and power house survey for the H. G. Acres & Co., Niagara Falls, Ont., was directed by Jasper Inga, field supervisor, and K. C. Fellows, resident engineer, with W. G. Heslop, professor of civil engineering, University of British Columbia, and former transmission line executive with the Ontario Hydro Commission, handling the transmission line survey.

More than 2,000 ft. of test holes were diamond-drilled during this survey in 18 different locations by the T. Connor Diamond Drilling Co. to obtain data for dam abutments, tunnel rock and power house foundations. The results of the various surveys were assembled into a final report by H. G. Acres & Co. and have recently been presented to Pacific Mills, Ltd.

No decision has yet been made as to whether or not work will be undertaken on this project.

Correction

In an item about the foundations for the new cyclotron at the University of Chicago in our issue of Oct. 30 the statement about the amount of concrete used was erroneous because of a typographical error. The pour consisted of 600 cu.yd. for the first day and the total required was 1,600 cu.yd.

Combat lake erosion in U. S. and Canada

Ohio and Ontario study problems of shore protection on Great Lakes

George B. Sowers, director of public works for Ohio, declared in Toledo recently that although high water in Lake Erie and not sand dredging causes the shore erosion, there is not enough sand left on the lake-bottom to supply the construction industry and to build up beaches.

Mr. Sowers met with 50 producers and users of sand from lake ports. The conference was arranged by the Toledo Port Commission to consider how the proposed stopping dredging next year would affect construction, whether dredging should be limited and royalties larger, and how much sand Toledo needs.

Simultaneously, representatives of 25 municipalities in the Province of Ontario were calling for the organization of the Ontario Lake Shore Protective Association. It was advocated that Canadian anti-erosion measures for Lakes Erie and Ontario should be patterned after United States measures which authorize a general shoreline investigation at federal expense and federal participation in the protection of shores of public-owned property.

While Mr. Sowers believes that attempts to cure erosion with sand alone are useless, he is of the opinion that well-designed shore structures might trap wandering sand and rebuild the beaches to stop erosion. Ohio has already taken steps to combat erosion but the very small sum of money available is limiting the state's help to privately owned shore properties, he said.

Urge enforced speed curb on Pennsylvania turnpike

The National Safety Council has recently urged the strict enforcement of speed limits as a means of reducing accident on the Pennsylvania Turnpike.

The council cited the enforced 55-mile an hour limit on the Merritt Parkway, in Connecticut, as the primary reason why accidents are fewer on that super-road than on the Pennsylvania Turnpike where a 70-mile an hour high for automobiles exists.

The council made its statement in response to questions on how the turnpike could be made safer and the eastern extension be improved over the existing 161-mile Harrisburgh - to - Pittsburgh route.

Economy and utility in Macon fiberboard mill

Design and layout of the new groundwood fiberboard mill of Armstrong Cork Co. near Macon, Ga., (*ENR* Apr. 24, vol. p. 705) afford economy of construction with maximum utility, at a reported cost of about $5,000,000. The 1-story steel-frame, structural-tile faced, L-shaped plant has overall dimensions of 1,250 x 400 ft., and is divided into a fabrication and warehouse section, a dryer or connecting section, and a wet-process section. The production and warehouse area is about 5½ acres.

The building takes advantage of a sloping site so as to be two stories high at the south end for pulping and board-forming processes. This permits the use of gravity in discharging pulp. It also eliminates the need for deep pits in the pulping operation and has permitted the locating of machinery at various levels so that use of ladders, catwalks and operating platforms is kept to a minimum.

The plant has 30,000 sq. ft. of glass block on the south and west sides, with 16,000 sq. ft. of clear glass on the north and east sides. Roof construction consists of 2x6-ft. precast concrete slabs covered with one inch of insulation and built-up tar and gravel roofing. Rolled beams, instead of trusses, are used to support the roof.

Floors are generally 6-in. concrete slabs, reinforced with 6x6 by No. 6 steel mesh. Slabs supported on beams are reinforced with intermediate grade deformed steel bars bent up over supports for continuity, and in the warehouse, the floor is 7-in. thick. All concrete floors were finished with metallic floor hardener using 70 lb. of hardener and 25 lb. of cement per 100 sq. ft. of floor.

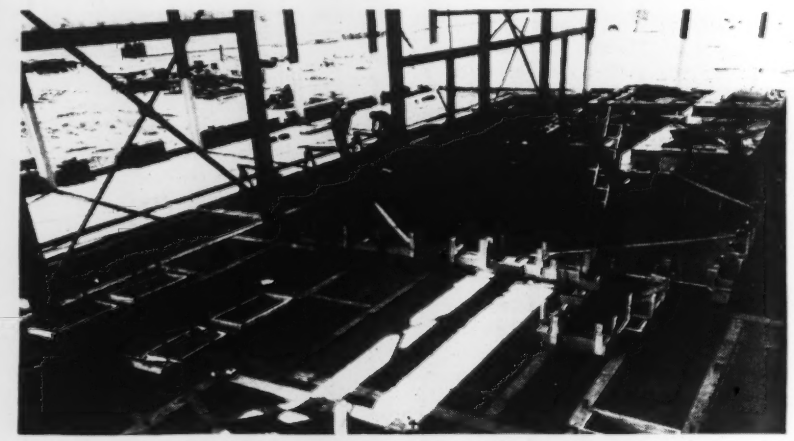
Foundations consist of concrete spread footings designed for 3,000-psf. soil pressure under equipment and 4,000-psf. under main building columns.

Heating for the warehouse and fabricating buildings is supplied by four 1,500,000 Btu. natural-gas heaters set on the floor against the wall and supplemented by smaller 400,000 to 500,000 Btu. unit heaters. Dampers provide control for intake of fresh air and recirculation of inside air.

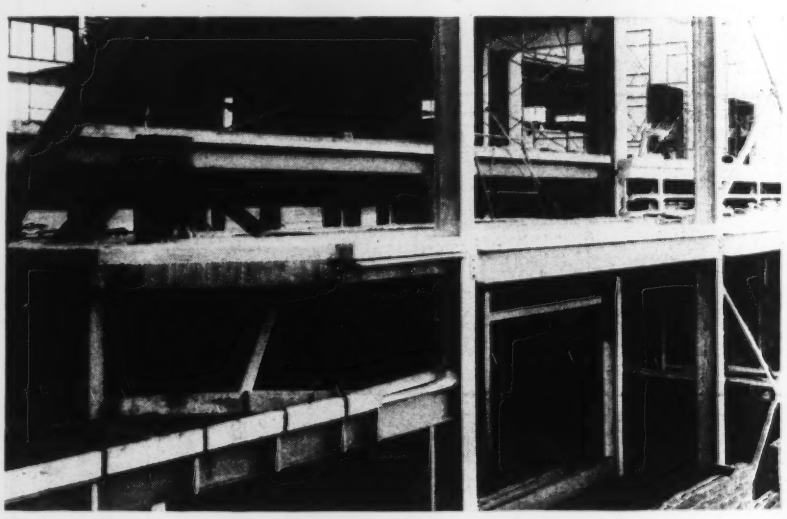
The building is lighted by incandescent lamps, with the exception of finishing machine areas or where extra light is required, and there fluorescent fixtures are provided.

Process water, of which a great deal will be used, is obtained from artesian wells, while sanitary and potable waters will be purchased from the city of Macon.

General view of the fiberboard mill near Macon, Ga., from the east, showing the office building at lower left.



A corner of the wet process building shows forms and wire mesh reinforcing. Foundations are designed to carry grinders weighing a total of 55,800 lb.



View of the wet process building showing the various floor levels required on special process design. The second level from the top is for railroad tracks.

The main office of the plant will be in a 44x189-ft. reinforced brick structure west of the main building. It will be air-conditioned from a central system and will have 1,120 sq. ft. of heat-absorbing plate glass. The precast concrete slab roof will be covered with 2 in. of insulation and tar and gravel roofing.

Rust Engineering Co., Pittsburgh, Pa., with B. M. Hutchins, project engineer, was architect and engineer. Henry Boettcher was associate architect for Armstrong Cork Co. and A. A. Becker, resident engineer. Beer Construction Co., Atlanta, Ga., was the general contractor, with Eugene Boeke as superintendent.

AWWA group sees costs climbing

Cost of building water supply and other sanitary facilities probably will continue to climb during the next few months, the Four States section of the American Water Works Association was informed at its 31st annual conference last week in Washington, D. C. Chlorine will also continue in short supply, speakers said.

Although he commented that his figures were "very general," Francis S. Friel of Albright and Friel, Philadelphia, Pa., told the group it would be "several months" before cost of constructing municipal structures would level off. He added that even this "leveling off" might leave costs at 150 to 160 percent of prewar.

Although the capacity of U. S. plants to produce chlorine will total around 1,400,000 tons yearly at the end of 1947, J. O. Logan of the Mathieson Alkali Works, Inc., New York, told the group that chlorine will be short for some time. "Demand for chlorine for treatment of water supply and other municipal services now is only a small percentage of the country's producing capacity," he said, "but industrial chlorine requirements have grown much more rapidly than production capacity."

Bacteriological quality control

In a paper on "Control of Bacteriological Quality in Distribution Systems", George Schuker, sanitary engineer, Baltimore, Md., outlined a method whereby the Baltimore area was broken up into districts corresponding to the census tracts in a spot-sampling program.

Carl A. Hechmer of the Washington Suburban Sanitary Commission said that greater care must be used in laying out distribution systems to avoid deterioration of the quality of water and its free chlorine content. This would include the elimination of dead-end mains as much as possible.

"Too frequently when a new main is put into service," he added, "tests indicate that the pipeline has been thoroughly sterilized, whereas continuing tests may show this condition deteriorating." Mr. Hechmer said he took this view because the materials used to seal the joints of a line may be contaminated when installed and continue to contaminate the water in the main long after new pipe is placed in service, although tests immediately after sterilization would not show this.

A description of the serious difficulty that arose in a large Washington, D. C., housing development when the water supply to the project was interrupted and the flush valves in the plumbing system failed to function properly when service was resumed, was contained in another paper that created much interest. Prepared by A. P. Bell of the Washington Bureau of Public Health Engineering, the paper recommended that the water supply to such establishments should not be through a single connection, but by multiple connections when this is readily possible. It also recommended that engineers give more consideration to whether or not the flush valves they are using will result in unstable operation when the supply to a system is interrupted.

Charles P. Abraham of the Lancaster, Pa., water department is the new chairman of the Four States section, and Edwin A. Schmitt, head engineer with the Washington district office of the Corps of Engineers, vice-chairman.

OK $2 million Indiana sanitation projects

The Indiana Stream Pollution Board last week approved final plans for sewer and sanitation projects totaling more than $2,500,000.

The projects approved include the long-debated sewer and treatment plant system for Columbus; sewers for the towns of Whiting and Hammond; five lift pump stations in the new South Bend systems and other works in Indianapolis and in Chicago.

New England storm causes much damage

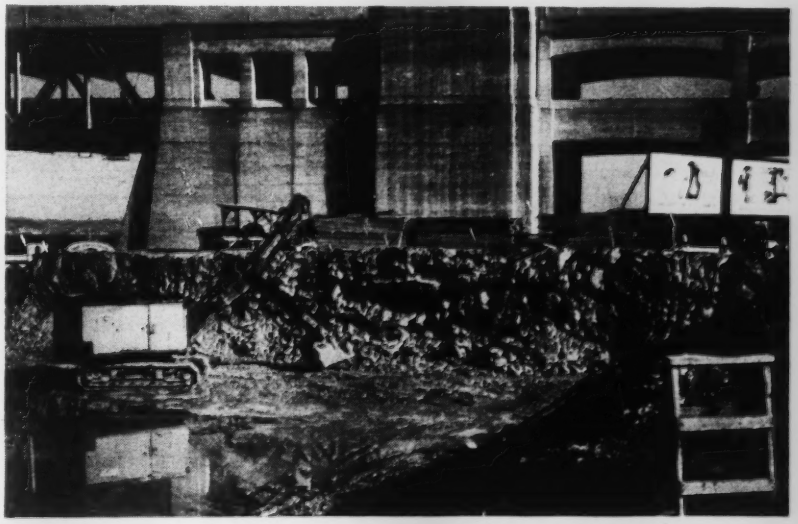
New England's construction problems were greatly multiplied on Nov. 12, when a northeast storm, accompanied by heavy rain and snow, caused damage estimated at several million dollars. Cape Cod and the off-shore islands of Nantucket and Marthas Vineyard suffered heavily.

In Massachusetts and Greater Boston streets and cellars were flooded and highways and railroads made impassable with fallen trees and poles.

On Cape Cod light and telephone systems were put out of commission. An emergency power plant from the state police barracks furnished light for Cape Cod Hospital in Hyannis. In South Yarmouth school pupils were marooned in the building by flooded streets. Seas from Nantucket Sound swept far inland on the Cape. Seawalls were demolished and cottages damaged. Bridges and highways were washed out there and in other parts of the state.

On Nantucket island five 325-ft. steel towers recently constructed by the Civil Aeronautics Board, were knocked over by the gale. Marthas Vineyard was also hard hit. One hangar at the local airport was demolished and another badly damaged.

Service of more than 12,000 telephones in the New England states was disrupted by the storm. Boston's flooded mains caused a seepage into the underground cables of the New England Telephone Co.



***Bridged Out**—Surprise action a week ago by the California Toll Bridge Authority approving two sites for Bay bridge crossings (ENR Nov. 20, vol.p. 699) forced halting of work on a $1,000,000 sailors' union building which was to be located next to the anchorage of the existing structure. About $100,000 of work had been done when it was ordered stopped.*

N. C. Grover honored by Washington engineers

Nathan C. Grover, for many years chief hydraulic engineer of the U. S. Geological Survey, at the Nov. 20 annual dinner meeting of the Washington Society of Engineers received the engineering award of that organization in recognition of his outstanding professional achievements. It was the second time the award has ever been made during the 38 years the society has been active.

In 1904 Mr. Grover went to Washington as assistant to the chief engineer of the Reclamation Service of the Geological Survey. In 1907, when the reclamation service was formally organized as a separate bureau of the Department of the Interior, Mr. Grover resigned from the Survey to accept a position with the J. G. White Engineering Co., New York City, as hydraulic engineer. In 1911 he returned to the survey as chief engineer of the Land Classification Board, and in June, 1913, was appointed chief hydraulic engineer, a position he held for 26 years or until his retirement on Jan. 31, 1939, at the age of 71 years. In August, 1942, he returned to the Survey as a special consultant to the chief hydraulic engineer, a position he now occupies.

Firm price quotations urged by Carolina AGC

An appeal to national manufacturers and material producers to quote firm prices for entire specific construction jobs was adopted at the 27th annual convention of the Associated General Contractors of America, Carolina branch, held last week in Augusta, Ga.

The association went on record that, where consistent, owners of properties will be furnished fixed price proposals by the contractors as one part of their plan to keep construction prices as low as possible.

At the same time a resolution was adopted for the Carolina Branch to petition the national association to urge industries of national scope to resume everywhere firm price quotations for specific jobs.

The group elected Robert H. Pinnix, of Gastonia, N. C., as president to succeed C. Y. Thomason, of Greenwood, S. C., who becomes ex-officio member of the official staff. Other officers elected are W. T. Potter, of Greenville, S. C., vice-president; C. P. Street, of Charlotte, N. C., re-elected treasurer; and Robert Patten, of Charlotte, re-elected executive secretary.

May use Arizona mines for military purposes

A firm of New York engineers headed by Guy B. Panero, international mining authority, now is studying abandoned Arizona metal workings for possible development of underground military installations. (ENR June 5, vol. p. 916)

Department of the army sources unofficially say that the search is being conducted in co-ordination with the Corps of Engineers and admit there is considerable activity in the Yuma sector.

Bureau of Reclamation wants more engineers

The U. S. Civil Service Commission has announced that applications for engineer positions at $5,905 to $9,975 a year will be accepted until further notice by the executive secretary, Central Board of U. S. Civil Service Examiners, Bureau of Reclamation, Building 1A, Denver Federal Central, Denver, Colo.

The positions to be filled are in Bureau of Reclamation offices in Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming. No written test will be given; candidates will be rated on their experience and training relevant to the duties of the position.

Applications are desired from those individuals whose experience and training qualify them particularly for engineering or engineering administrative work within the specialized scope of the Bureau of Reclamation. Further information and application forms may be obtained from Civil Service regional offices, or the U. S. Civil Service Commission, Washington 25, D. C.

New laws to regulate well-drilling in N. J.

A new law to regulate the drilling of wells for water supply in New Jersey, gives the Division of Water Policy and Supply of the state Department of Conservation the right to delineate areas where diversion of subsurface waters exceeds or threatens to exceed the natural replenishment of such waters. Within such areas no one is now allowed to pump over 100,000 gpd. without first obtaining a permit from the division.

A second new act controls the drilling of new wells in that it licenses well drillers and makes it necessary for owners to obtain a permit before commencing a new well or any excavation over 100 ft. in depth.

Copies of the new laws may be obtained from the Division of Water Policy and Supply at 28 West State Street, Trenton, N. J.

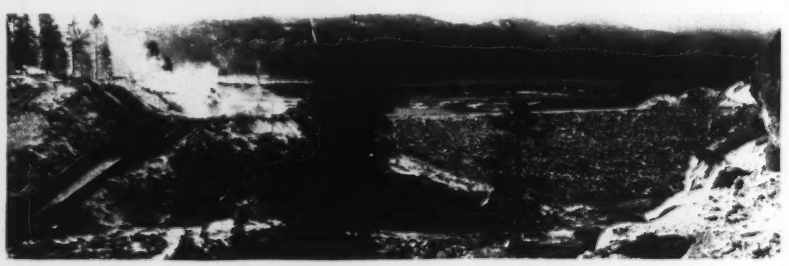
Engineers study proposed Chesapeake Bay crossing

Ole Singstad of New York and Palmer and Baker, Inc. of Mobile, Ala., are now engaged on studies for a proposed crossing of Chesapeake Bay at Sandy Point, near Annapolis, Md.

Governor Lane had requested the Maryland State Roads Commission to present an up-to-date report on the possibilities of a tunnel crossing to be studied in comparison with the feasibility and cost of a bridge.

An important part of the investigation is the determination of the depth of firm bottom needed to support a tunnel crossing.

Robert M. Reindollar, chairman of the commission, says that a bay crossing is vital in linking the western and eastern shores.



Newest Idaho Dam—Nearing completion on the North Fork of the Payette River near Cascade, Idaho, is Cascade Dam, a Bureau of Reclamation project under contract to Morrison-Knudsen Co., of Boise. With the embankment nearly completed, work is now centered on construction of the spillway at left. The dam is 85 ft. high, 700 ft. long at crest, and is expected to supply water for 25,000 acres of new farmland, and supplemental water for 83,000 acres already under cultivation.

OBITUARY

Frederick A. Gaby, 69, engineer, who served the Ontario Hydro-Electric Commission for 27 years, as chief engineer till 1934, died at Toronto, Ont., Nov. 14. He was graduated at the University of Toronto, 1904, and got an honorary D.Sc. from the same institution in 1924. In 1934 he became assistant to the president of the Canadian Pacific Ry.

E. H. Neuhart, 61, county highway engineer at Bolivar, Mo., for almost 30 years, died there Nov. 11.

George E. Cook, 75, retired civil engineer, died recently in Albany, N. Y. Mr. Cook retired in August from the U. S. Geological Survey in Albany after serving nine years with the federal government. For many years, he served as an assistant hydraulic engineer to the late Robert E. Horton, consulting engineer in Voorheesville, N. Y.

George G. Powell, 69, outstanding commissioner of works for Toronto, Ont., died there Nov. 15. He was a graduate of the old School of Practical Science of the University of Toronto, receiving a bachelor's degree there in 1903. He joined the works department in 1906 and in 1912 he became deputy civil engineer and held that position until Nov. 7, 1945, when he became commissioner of works.

Mortimer J. Nicholson, 65, deputy county engineer at Kansas City, Mo., for six years, died Nov. 4. For 16 years he was employed by the city public works department.

John Joseph Coan, 74, president of the J. J. Coan Machinery Co., Salt Lake City, Utah, died Nov. 8. Mr. Coan contracted for and built the first highway through Parley's canyon about 30 years ago.

Hilding Ernest Berger, 44, superintendent of concrete on a large air base project at Fairbanks, Alaska, died there recently. He was a graduate of Perdue University.

Edward F. Gibson, consulting engineer for The International Salmon Commission and retired office engineer for the Seims-Drake-Puget Sound Co., died recently at Seattle, Wash.

Sidney Smith, 63, civil engineer and dredging expert who retired two years ago and went to Indianapolis, Ind., to live, died there Nov. 10. He had participated in large construction projects throughout the United States. Employed by Bates & Rogers Engineering Co. in Cleveland, Ohio prior to the war, he served overseas as a lieutenant colonel for 18 months with the 107th Engineers in the 32nd Division. He was the principal engineer on the Fort Peck Dam at Fort Peck, Mont., and also was vice-president of the McWilliam Construction Co. in New Orleans, La., before retirement.

Walter G. Hahn, a structural engineer for the Wisconsin Bridge & Iron Co., and formerly for 37 years an engineer for the Worden-Allen Co. died in Milwaukee, Nov. 9.

Ray E. Palmer, 60, senior civil engineer of the New York State Department of Public Works in the Chemung and Steuben counties area, died in Elmira recently. He had been employed by the state about 38 years.

John S. Godfrey, 53, retired Army construction engineer and secretary of the Middle Township Sewage Commission, of Cape May Court House, N. J., died Nov. 12.

William E. Roberts, 67, contractor who helped build the Camden, N. J., bridge over the Delaware River, died Nov. 8 at Gibbsboro, N. J.

Gerald Francis Hayward, 68, civil engineer, Ontario Department of Highways, died at Toronto Nov. 13. Mr. Hayward served in the Boer War and had been stationed at Owen Sound, Ont., recently.

Hans Richard Greisser, 47, engineer and architect, Chicago, Ill., died Nov. 10. He studied civil engineering at the University of Wisconsin and in Europe.

Harry Kreuger, 55, civil engineer in the U. S. soil conservation department at Milwaukee, Wis., died Nov. 15.

MAJOR MEETINGS

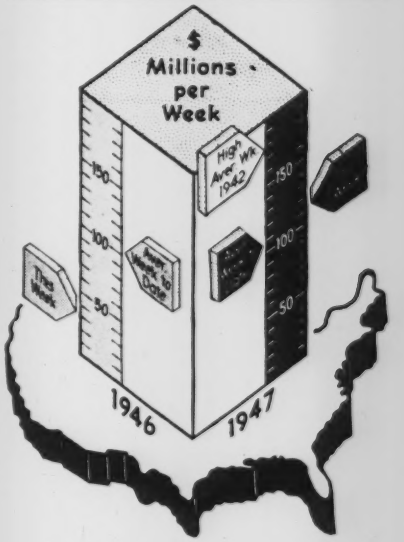
Highway Research Board, 27th annual meeting, National Academy of Sciences and National Research Council, Washington, D. C., Dec. 2-5.

National Society of Professional Engineers, Statler Hotel, Buffalo, N. Y., Dec. 4-6.

Society for Experimental Stress Analysis, annual meeting, Hotel Pennsylvania, New York, N. Y., Dec. 4-6.

American Society of Agricultural Engineers, winter meeting, Stevens Hotel, Chicago, Ill., Dec. 15-17.

CONSTRUCTION ACTIVITY



As Reported this week to . . .
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only (Thousands of Dollars)

	Week of Nov. 27 1947	Cumulative 1947 (48 wks.)	Cumulative 1946 (48 wks.)
Federal	$11,429	$569,749	$589,055
State & Mun.	55,680	1,690,665	1,322,760
Total Public	$67,109	$2,260,414	$1,911,815
Total Private	49,693	2,895,434	2,911,364
U. S. Total	**$116,802**	**$5,155,848**	**$4,823,179**

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Dollar Volume (Thousands)

Type of Work	This Week	Cumulative 1947 (48 wks.)	Cumulative 1946 (48 wks.)
Waterworks	$17,931	$125,993	$101,481
Sewerage	5,100	161,962	105,769
Bridges	3,152	174,583	122,589
Highways	12,620	738,880	725,581
Earthwork, Waterways	2,839	278,028	319,228
Buildings, Public	23,835	551,650	388,134
Industrial	10,094	817,527	969,754
Commercial	28,245	1,690,623	1,758,174
Unclassified	12,986	616,602	332,469

NOTE: Minimum size projects included are: Waterworks and waterway projects, $22,500; other public works, $40,000; industrial buildings, $55,000; other buildings, $205,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1947 (47 wks.)†	Cumulative 1946 (47 wks.)
NON-FEDERAL	$2,228,936	$1,343,691
Corporate Securities	933,442	393,920
State and Municipal	1,047,783	724,171
Fed. Aid Highway	247,711	225,000
FEDERAL	818,729	1,714,695
Total Capital	**$3,047,665**	**$3,057,786**

†Current figures not available. 46-week cumulative total has been adjusted to $3,006,527,000 as the result of a revision in state and municipal bonds to $1,033,620,000.

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost	Nov.'47	429.30	206.36
Building Cost	Nov.'47	322.27	174.21
Volume	Oct.'47	234	103

EDITORIALS

VOLUME 139 NUMBER 22

November 27, 1947

Research and Public Service

A RECORD rich with accomplishment and of broad benefit to the engineering profession has been compiled by the research laboratories of the U. S. Bureau of Reclamation. This is evidenced in the series of articles on the work of the laboratories, the concluding installment of which appears in this issue. Concerning itself with a look at developments ahead, this final article adds strong assurance that the laboratories' future activity will continue to be productive of new technical knowledge. A mere listing of some current research investigations —notably, concrete mixing, earthwork compaction and reservoir silting—reveals the fundamental character of the work under way. Naturally, these studies are directed specifically to the problems faced by the bureau. But these problems are not unique to the design and construction of reclamation works. In most cases they are of universal concern. It is obvious, therefore, that the research laboratories maintained by the bureau represent, in the widest sense, a great public-service enterprise. From these workshops of science emanate findings of profound influence in all engineering and construction practice.

The Marshall Plan and Construction

WHAT WILL THE MARSHALL PLAN mean to American business? Because the answer to this question is of such commanding importance to world peace and prosperity, an analysis in as precise terms as is presently possible has been prepared by the McGraw-Hill department of economics, and is published as a 12-page insert in this issue. The report is recommended reading for every engineer and construction man. However, since it is necessarily confined to the broad general dimensions of the Marshall Plan, it would be well to ponder in what more specific ways this great economic program may affect the American construction industry. That it will affect it is apparent from Secretary Marshall's description of the plan as one "of *construction*, production and recovery" for western Europe. Two ways in which the effects may be felt can be suggested. First, there is the probable requirement for American engineers and construction men to advise with European countries on specific projects related to coal-mine rehabilitation, railroad and waterway improvements, housing and factory rebuilding, as well as hydroelectric and other utility construction. Such consultation would be the normal procedure of a private financial institution making a loan, and there is no reason why governmental lending should be any different. It is to be noted that the plan contemplates that our aid on capital improvements will be in the form of loans as contrasted with such consumable items as fuel, fertilizer and food, which would be outright grants. A second effect on American construction will result from the export of such short-supply items as freight cars, pneumatic tools, conveyor belting, tractors, turbogenerators, electric motors and, above all, steel. Whatever in such categories is sent out of the country reduces the supply for our own construction needs, and it may raise the price of that which remains for domestic use. There seems little doubt but what the objectives of the Marshall Plan will be supported by Congress with some form of aid. The important thing for the construction industry is first to understand its implications and then to lend all possible aid in getting it properly administered.

Help Train Apprentices

EVERYBODY is blaming the other fellow for the high cost of construction in current Congressional hearings, and there appears to be little that any individual or organized group can do about it because such a multitude of factors affect building costs. But there is one place where the individual contractor can help, and that is in the training of apprentices. At last week's meeting of the Construction Industry Advisory Council, M. M. Hansen of the Apprentice Training Service, U. S. Department of Labor, said that 200,000 men should be added to the 104,000 now in training. This can only be done through the help of contractors who are willing to take on men for apprentice training. The need is especially great in small cities. Here is a concrete opportunity to help bring construction costs down by increasing the supply of trained mechanics.

Old Concrete With a Good Record

AN INTERESTING SIDELIGHT on the strength of the 40-year old concrete at Holtwood Dam reported

on p. 53, pertains to the plant for mixing concrete and the equipment to place it. From mixers to travelling-multiple derricks, the plant handled 240 cu. yd. of concrete hourly plus 20 percent more of pudding-stones. The derricks operated on a 2,300 ft. long, 50 ft. wide temporary concrete-arch bridge, which was built in 68 days. Forms were wood-lagged steel frames. Materials moved in a well-planned circuit that avoided site confusion. That good concrete was made seems to have been rather incidental to the construction story (told in 25 pages in *Engineering News* and *Engineering Record*), but that it was good concrete is attested by its present strength of 5,400 psi. We salute the builders of Holtwood Dam.

Railroad Construction Today

FEW FIELDS OF CONSTRUCTION reflect the many labor-saving devices and time-saving methods developed during the past two decades as does railroad construction. As described elsewhere in this issue, this type of work has been revolutionized to become a highly mechanized operation.

There are many who will remember the six-team loader that elevated excavated material into horse-drawn dump wagons, or the hand-dumped, horse-drawn slips, or the construction of high fills by dinkey engine and railroad dump-cars operating on trestles. Today these operations are more highly mechanized, and the quantities moved and the rates are beyond the fondest expectations of yester-years. Similarly, all tracklaying operations have been mechanized, jacking, tamping, spiking and nut tightening being done with power tools.

Perhaps the two most notable advancements in railroad construction are the compaction of embankments and stabilization of ballast. The former follows closely the handling and placing methods developed in building earth dams where heavy, pneumatic-tired equipment is used to secure proper compaction. For stabilization mechanical tampers are employed that produce a uniformity impossible to attain by the old shovel-and-foot methods of ballast compaction. As a result, the "breaking-in" period of new track with its months of expensive maintenance has been reduced to only a few days of routine inspection.

Continued improvement of equipment and methods should encourage the relocation or reconstruction of many stretches of outmoded railroad line to decrease operating and maintenance costs while providing increased service and passenger comfort.

The Maine Turnpike

THE MAINE TURNPIKE which will be opened to traffic on Dec. 1 is a construction achievement to be hailed and a toll facility to be watched. Built in two working seasons, this four-lane, 47-mile superhighway from Kittery to Portland was finished in 21 months from the time engineers were engaged. By concentration on right-of-way and grading, the 1946 work season was utilized. Contracts were let last fall to permit winter work and preparation for an all-out attack in early spring on the final grading and paving. The story, as told in this issue, is a construction achievement in which each participant—engineer, contractor and supplier—may take pride.

Opening the toll turnpike to use also opens the way to a critical study of the traffic it draws from existing roadways and that which the new facility itself may generate. It is the first U. S. highway in nearly a century to be financed privately on the basis of anticipated revenues, with no subsidy from government agencies. Any extension of this turnpike, will depend on public acceptance as measured by income from tolls. It will be watched with interest by proponents of other privately financed toll highways.

Investment per mile on the Maine Turnpike is about double that for the Pennsylvania Turnpike, which received considerable subsidy from public funds. Toll rates, however, are about the same for both roads (about one cent a mile), which is equivalent to a gasoline tax of 15 c. a gallon. If experience in the next few years shows that many people are willing to pay so high a tax for the convenience provided by this road, then it would appear that Maine could provide similar improved highways at less cost to the users by a moderate increase in the gasoline tax. This would eliminate the quite considerable cost of toll collection and would expand the usefulness of new highways by freeing them of the access restrictions that are inherent in a toll highway.

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Fig. 1. Curves generally are limited to one-degree on the Rock Island's 72-mile relocation project in Iowa.

Rock Island Completes Relocation in Iowa

***Contents in Brief**—With the last of five relocation projects completed, the Rock Island's 72½ miles of new single-track railroad across southeastern Iowa and 15 miles in Missouri shortens the distance from Kansas City to Chicago by 12.2 miles. Grade reductions eliminate 1,020 ft. of rise and fall, while the new alignment reduces the total central angle of curvature by 2,900 deg.*

STREAMLINERS of the Chicago, Rock Island and Pacific Railway Co. are now cutting across the southeastern corner of Iowa at top speeds of 100 mph. while the length of diesel-powered freights is limited only by the number of cars (125) that can be handled on the passing tracks.

This greatly improved service is the result of a five-year relocation program, completed Aug. 15, on the main line route between Chicago and Kansas City.

The total improvement includes 87.6 miles of new track, mostly on new right-of-way. It replaces 99.8 miles of old line, and shortens the route by 12.2 miles. Running time from Kansas City to Chicago has been reduced by 1¾ hr., and operating costs will be lessened by the shortened line and reductions in curvature and grade.

Curves generally are limited to 1 deg. on the new line which was built to an operating grade of 0.5 percent. The new location contains a total curvature of 2,900 deg. less than the old one, while the total rise and fall has been reduced by 1,020 ft.

Benefits from reduced grade and curvature are apparent from the fact that one 5,000-class steam locomotive can pull a 5,000-ton freight over the new line, as compared with a maximum load of 2,300 tons on the old line which contained grades of 1.5 percent and 4-deg. curves.

There were, in all, five separate projects. The first one, completed in 1942, was 15.1 mi. of new line between Mercer and Mill Grove, Mo. The other four projects, all in Iowa, together with their completion dates, are: 20.7 mi. between Perlee and Eldon in 1944; 20.9 mi. between Paris and Centerville, 1945; 13.6 mi. from Floris to Paris, 1946; and 17.2 mi. between Ainsworth and Brighton, completed and placed in operation Aug. 15, 1947.

As shown in the accompanying map (Fig. 2), the old line between

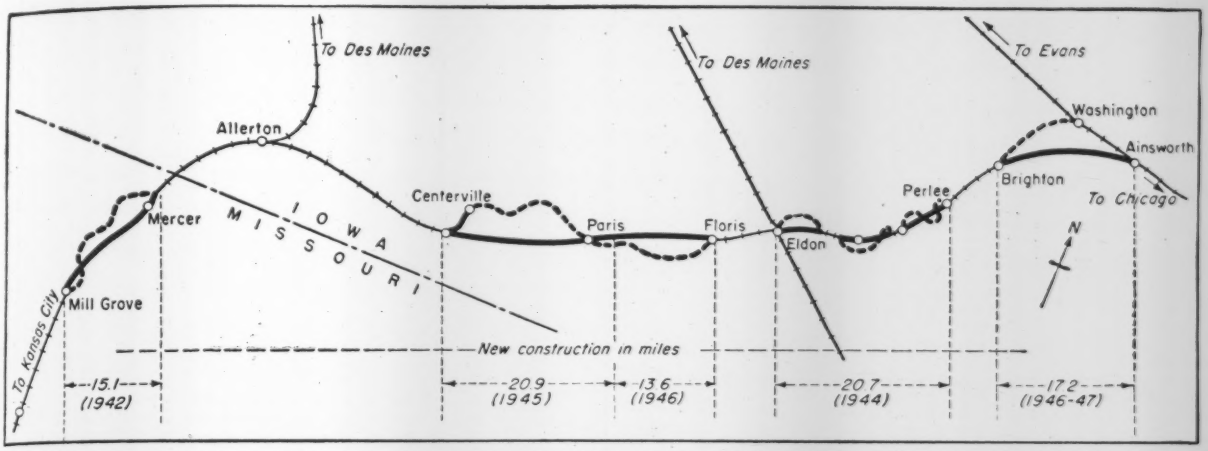


Fig. 2. The five relocation projects shown here in heavy lines have shortened the Rock Island line in Iowa 12.2 miles.

Brighton and Washington will be abandoned, but the original line from Ainsworth to Washington will remain in service as an important branch line connection to Des Moines. Mileage saved by the new construction, total reductions in rise and fall, and in the degree of curvature are shown in the accompanying table.

Construction on the Ainsworth-Brighton and the Floris-Paris projects, which is generally typical of the Rock Island's methods of building a new line, was done both by contract and with company forces and equipment. The contract work included clearing of right-of-way, fencing, drainage, and grade-crossing-elimination structures, all excavation and embankment, and installation of the subgrading.

From this point on, the company forces took over. They distributed ties and track material, laid the track, spread the ballast, raised and aligned the track, tamped the ballast and gave it its final dressing.

Heavy grading quantities

Due to the rolling terrain encountered in Iowa and the 0.5 percent operating grade to which the railroad was built, excavation quantities were an appreciable item. Those on the Ainsworth-Brighton section averaged over 100,000 cu.yd. per mile.

In general, the railroad embankment was built in 8-in. compacted layers and to a 24-ft. top width, with side slopes of 1 on 1½. To stabilize the embankment and, in some instances, to balance cuts and fills, 10-ft. berms were added at the toes and on the side slopes of the larger fills; the number of such berms depending on the height of fill. Other fills, built of less stable material, had slopes of 1 on 2.

The large quantities of excavation involved, and the fact that little rock excavation was encountered between Ainsworth and Brighton gave the contractor on that project an excellent opportunity to incorporate mass methods of earth moving.

However, two elements had to be reckoned with throughout the job. One was the unusually rainy season in a section of the country which usually has a subnormal rainfall during the summer. A total of 53 working days were lost on account of rain between the start of the final project

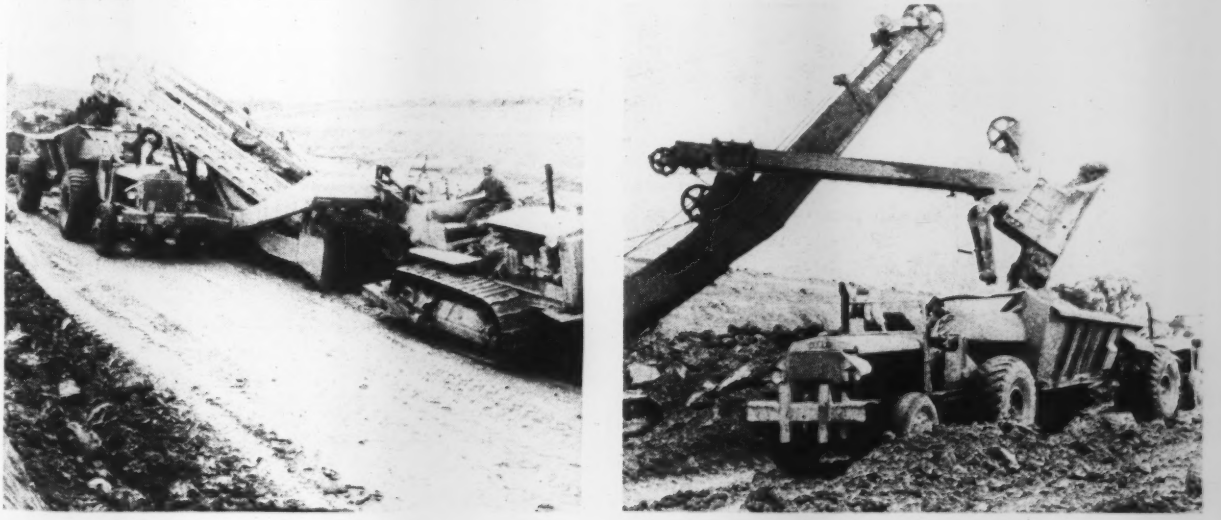


Fig. 3. Weather permitting, elevating loaders were used to good advantage (at left), but for wet material, power shovels and draglines were needed (at right).

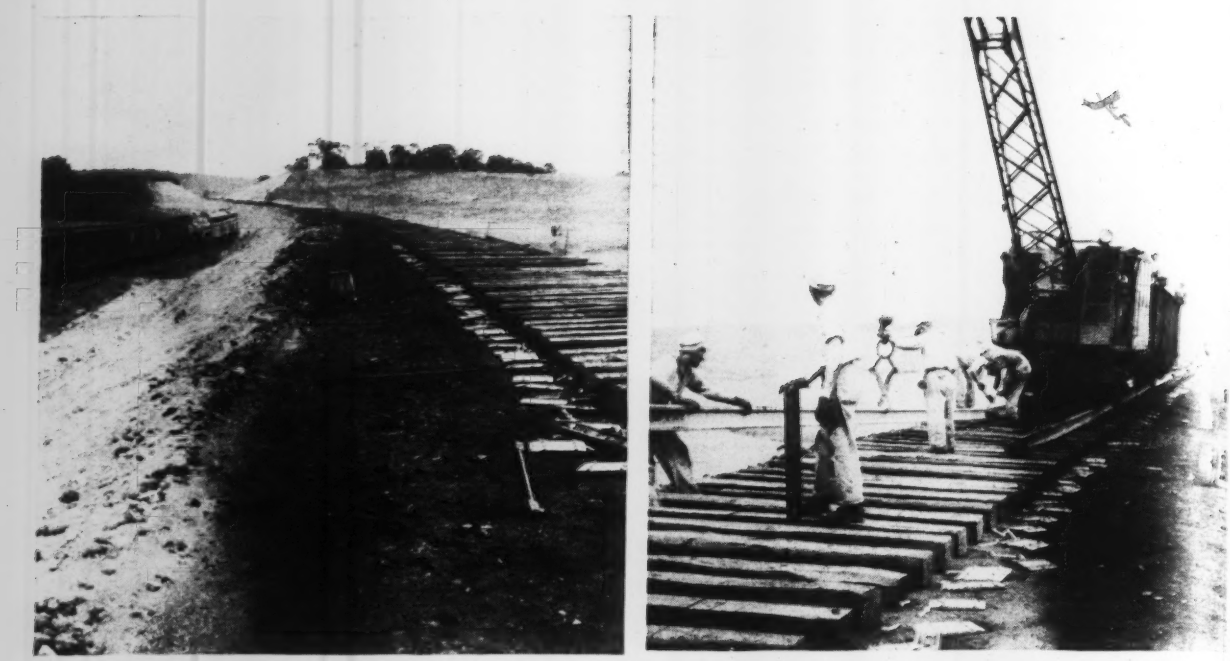


Fig. 4. Ties, tie plates and rail fastenings were hauled by truck and handplaced on the compacted subgrade (at left), and rails were laid by a locomotive crane (at right).

on May 20, 1946, and its completion on Aug. 15.

The other deterrent to speedy excavation was the unusual soil formation encountered, particularly as to the location of the groundwater table. Invariably the cuts consisted of 2 to 5-ft. of good top soil, easily excavated by scraper or power loader. But underneath was a layer of saturated soil from 2 to 8 ft. thick, which often required a dragline for excavating. Once this layer of muck had been removed, the remainder of the cut could be excavated similar to the top soil.

Carrying scrapers were used advantageously on short hauls. But instead of beginning at the top of the cut and excavating the material in horizontal layers, it was necessary to start at the forward face of the cut and establish a cutting plane on about a 30-deg. angle with the horizontal and extending completely through the saturated material. Then the pans could start loading in the top stratum of good soil, gouge through the saturated material and complete their load in the dry subsoil.

On long hauls, the contractor removed the top soil by an earth loader, excavated the saturated layer by dragline, including about 2 or 3 ft. of the semi-hardpan subsoil, then completed the cut with the power loader, using a fleet of fast moving trucks in all cases.

In spite of the ever present stratum of saturated material, excavation progress was good. On one 800-ft. haul the contractor on the Ainsworth-Brighton project moved 143 scraper loads in 2 hr. Each scraper averaged 18 cu.yd. On another haul of similar length, 10,000 cu.yd. of excavation was moved in 9 hr.

Some idea of the magnitude of grading operations on the Ainsworth-Brighton job can be gained from the amount of contractor equipment involved. It included: one 750-cu.yd. per hr. power loader; two draglines, 1½ and 2½ cu.yd.; 28 crawler-type tractors; 18 earthmoving scrapers having capacities of 12 to 30 cu.yd.; 16 dump trucks; 6 motor graders; 5 sheepsfoot rollers; 25 miscellaneous trucks, service cars and grease trucks.

The contractor's personnel included 9 supervisors and office workers, and 195 workmen. To provide inspection and engineering on the grading and structures required a crew of 21 engineers, including one engineer-in-charge and two office men.

Compacted by heavy equipment

In general, all roadway embankment was compacted to at least 90 percent standard compaction at optimum moisture content. Relatively little sheepsfoot rolling was required other than to knit the loose material together, as adequate compaction was secured by the heavy earthmoving equipment.

Earth embankments and cut sections were finished to a 3-in. crown over their 24-ft. shoulder-to-shoulder widths. They were covered with a layer of mineral refuse from zinc smelters, which was moistened as necessary. It was spread with motor

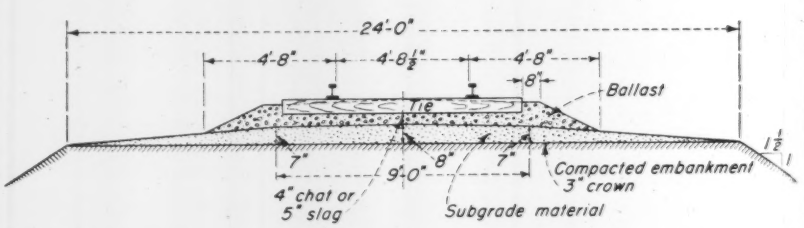


Fig. 5. Cross-section through the roadbed shows 8 in. of compacted subgrade and 4 in. of chat or 5 in. of slag ballast under the ties.

graders, and compacted sufficiently by the pneumatic-tired trucks that hauled the material.

This subgrade material, termed "black top" by the railroad fraternity, was built to an 8-in. compacted thickness over a 9-ft. width centered under the track. It was feathered to zero thickness at the embankment shoulders, thus providing a well-crowned seal for the silty-clay loam in the embankment. Subgrading quantities averaged about 2,500 cu.yd. per mile.

The ballast proper, consisted of either a 4-in. compacted thickness of chat from zinc mines in Oklahoma or a 5-in. compacted layer of Chicago Slag, placed under the ties and on top of the subgrading. During the final dressing of the track this ballast was carried up to the top of ties at the center line of track and sloped down 3 in. at the end of the ties. Thus, the completed roadbed has a total of either 12 or 13 in. of compacted material beneath the ties.

Following installation of the subgrading the contractor performed his final operation—that of distributing the fastenings and ties, which were hauled by truck and deposited on the black top at about 100-ft. intervals.

Then, the railroad took over the completion of the job using its own equipment and labor.

Tracklaying procedure

Tracklaying procedures practiced by the Rock Island on the Floris-Paris project are typical of contemporary methods in use today. First operation of the railroad crew, following completion of the contractor's work on a section of new grade was to hand-place the ties to approximate alignment, and 21-in. spacing. Rail fastenings, tie plates and spikes then were distributed along the black top.

A fully revolving, self-propelled track crane, pulling a carload of rails, moved out onto the new track, laying the rails as it went along. Rails were picked up from the car behind the crane and placed on the ties directly in front. Joint bars were installed at each joint, bolts inserted and two nuts tightened. Prior to Jan. 1, 1946, the railroad installed 112-lb. rail on its new work. After that, however, the weight of rail was increased to 131 lb.

Rails were handled with a single

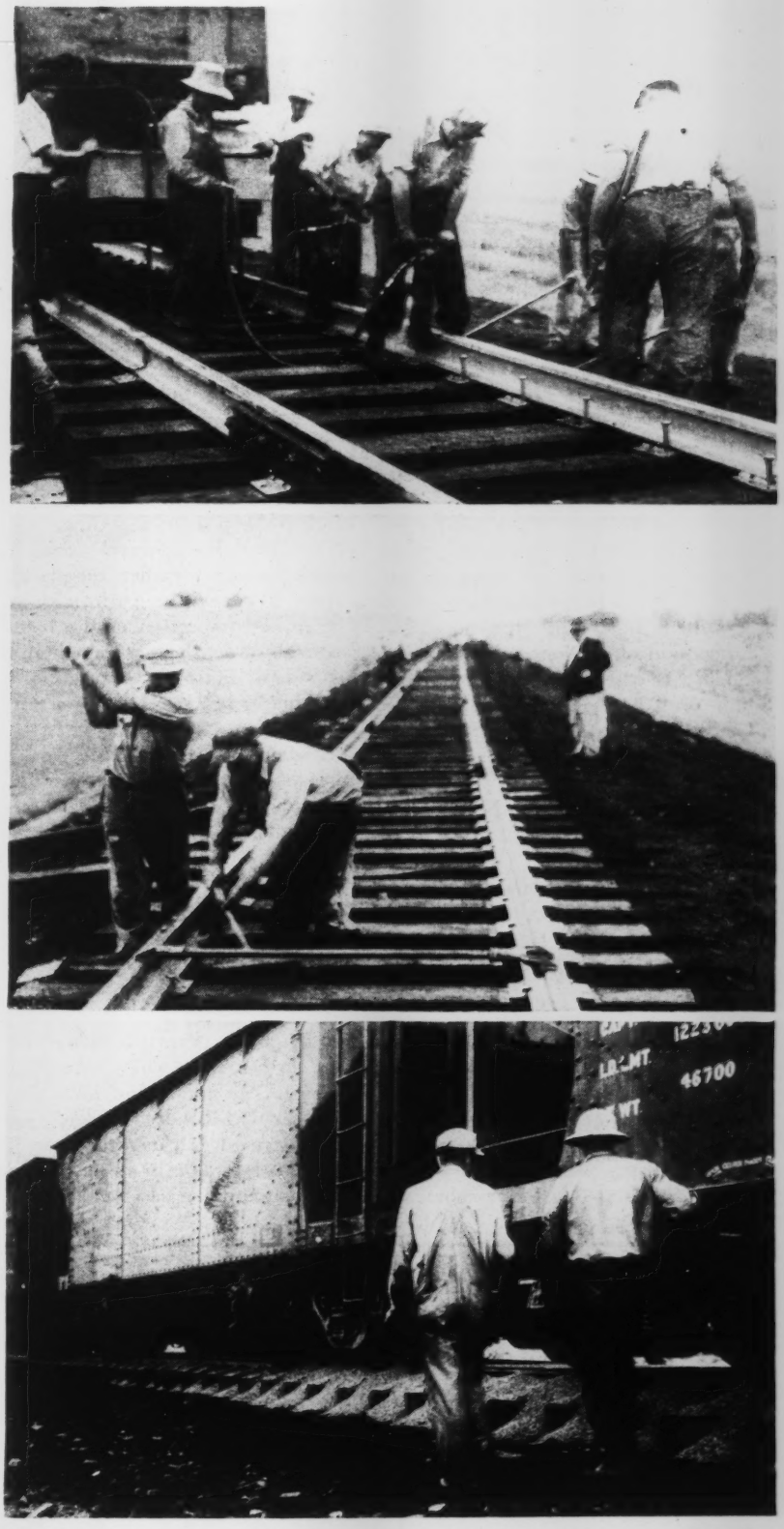


Fig. 6. Spikes for the "line" rail were hand-set and driven by pneumatic spike-driver (at top). The other rail then was gaged and hand-spiked at every fifth tie (at center) prior to full spiking. Then the ballast was spread direct from ballast cars (at bottom).

pick-up located slightly ahead of the center point. A tag line from the boom, attached to the rear and kept the rails level and facilitated their placement. Up to 2 miles of rail were laid in a single day.

Following immediately behind the tracklaying was the spiking gang. All spikes were hand-set in the tie plates of the line rail and driven with pneumatic spike-driving machines, powered by an air compressor moving along the rails.

Working close behind the main spiking gang, two 3-man crews handgaged the opposite rail with respect to the line rail, and hand-spiked every fifth tie. Then the remainder of the spikes were hand-set and the spike machine completed the spiking.

Nuts on all bolts in the joint bars were tightened with a gasoline-powered wrench which rode along on the rails. It had a swivel attachment that permitted tightening the nuts on either side of the rail, while an automatic release insured a total tension of 9,000 to 10,000 lb. in the 1-in. splice bolts.

Spreading the ballast

After a stretch of track had been laid and completely spiked, it was checked for alignment. Ballast then was delivered in regular ballast cars, dumped between the rails and spread evenly between the ties by railroad ties which slid along the rails in front of the car wheels.

One of the key points in this operation was to spread the right amount of ballast. Otherwise, considerable labor was involved in applying additional ballast or in removing any excess.

Probably the greatest single saving in labor resulted from mechanical tamping of the ballast. A hand-propelled, gasoline-powered jack moved along the rails and raised the track to the proper elevation while a self-propelled gasoline-powered tamper, also operating on the rails, mechanically tamped the ballast to the proper compacted depth under the ties.

Final operation was to check and adjust the track to correct alignment and to hand-dress the ballast. A well organized gang of 20 men raised and tamped 4,500 ft. of track per day, while a 16-man gang dressed about ½ mi. per day.

Although at this point the new track was completed it had to undergo a "breaking-in" period before heavy freights and high-speed passenger trains could operated over it safely. In the olden days this breaking-in period often took several weeks, depending on the weather, the stability of the fills and the uniformity and degree of compaction of the ballast. Now, however, due to contemporary methods of railroad construction, the breaking-in of a new line is a minor item.

Stretches of new track on the Floris-Paris project were placed in normal operation seven days after completion.

Bridges were a large item

Construction of bridges and drainage structures was an expensive item on some stretches of new line. Nine major bridges were required in the 17.2-mile project between Ainsworth and Brighton. Five are stream crossings, the longest of which is the Skunk River bridge containing four 100-ft. and six 70-ft. deck-girder spans. Three structures carry the new line over existing main highways and one carries existing tracks of the Minneapolis and St. Louis Railroad over the Rock Island.

In addition, five new timber overheads carry secondary highways over the new line. A multitude of small drainage structures also was required between Ainsworth and Brighton. When completed, this section of road will contain 830 ft. of multiplate culverts of 78 to 102-in. dia.; 3,950 ft. of corrugated metal pipe ranging in size from 30 to 66-in. dia., and 770 ft. of reinforced concrete box culverts varying from 6x6-ft. to 13x14-ft.

Although the construction of all bridges and drainage structures was done by contract, the railroad company furnished the main materials which include cement, reinforcing steel, piling and structural steel.

Railroad personnel

Relocation of the Rock Island single track line through Iowa was under the supervision of F. W. Thompson, chief engineer. W. F. Heimerdinger, acting assistant chief engineer, and C. H. Hardwick, engineer, maintenance-of-way. W. R. Throckmorton was field engineer in charge of the Ainsworth-Brighton job and G. H. Gaylord had direct charge of the Floris-Paris project. Bridges and drainage structures for both projects were designed under the supervision of H. T. Livingston, engineer of bridges.

Grading contractors on the Ainsworth-Brighton project, which involved a total of 2,000,000 cu.yd. of excavation, were S. J. Groves & Sons Co., Minneapolis, Minn., and Bowen & McLaughlin, Phoenix, Ariz., joint-venturers. Their construction superintendent was L. J. Klock.

Peter Kiewit Sons' Company, Omaha, Neb., held the grading contract on the Paris-Floris project, which involved 1,600,000 cu.yd. of excavation. William Olinger was general superintendent and Richard Knox, superintendent of construction.

Bridge contractors on the two projects included List & Weatherly, Kansas City, Mo.; Alexander & Repass, and the Kramme & Jensen Construction Co., both of Des Moines, Iowa; Condon-Cunningham Co., Omaha; and the Armco Drainage & Metal Products Co., Middletown, Ohio, which furnished and installed the corrugated metal pipe and multiple drainage structures.

TABLE OF ALIGNMENT AND GRADE CHANGES

Project (Date completed)	Total Length (mi.)		Total Rise & Fall (ft.)		Total Curvature (deg.)	
	Old	New	Old	New	Old	New
Mercer-Mill Grove, Mo. (1942)	16.4	15.1	489	340	598	182
Perlee-Eldon, Ia. (1945)	22.7	20.8	701	499	959	398
Paris-Centerville, Ia. (Feb. 1946)	24.8	20.9	635	392	813	103
Ainsworth-Brighton, Ia. (Oct. 1946)	20.9	17.2	722	394	834	109
Floris-Paris (Aug. 15, 1947)	15.0	13.6	517	417	618	124
Totals	99.8	87.6	3,064	2,042	3,817	916
Total reductions	12.2		1,022		2,901	

Concrete Tests from a 40-Year Old Dam

H. S. Mattimore
Engineering Consultant, Colonial Park, Penna.

***Contents in Brief**—Cores taken recently from concrete placed in Holtwood Dam on the Susquehanna River 40 years ago gave strengths averaging 5,368 psi. Concrete was 1-3-5 volume-proportioned, mixed in 1-cu. yd. mixers and transported in 1¼-cu. yd. buckets for placing by derrick. Wear on the overflow spillway, in 37 years of use, has averaged 3 in.*

CONCRETE from one of the major dams of the early 1900's has recently been tested, giving compressive strengths probably three times that of the concrete when placed about 40 years ago. The concrete is from Holtwood Dam, on the Susquehanna River, about 40 miles southeast of Harrisburg. The major portion of the 350,000 cu.yd. of concrete in the structure, then known as McCalls Ferry Dam was placed during 1906 and 1907. Due to a business recession, completion of the power project was delayed until 1909-1910.

It was from concrete placed in 1906-1910 that specimens recently tested were taken. In 1936 a number of 2⅛ in. core holes were drilled in several sections of the dam by the Pennsylvania Water & Power Co. to permit uplift measurements. (Uplift

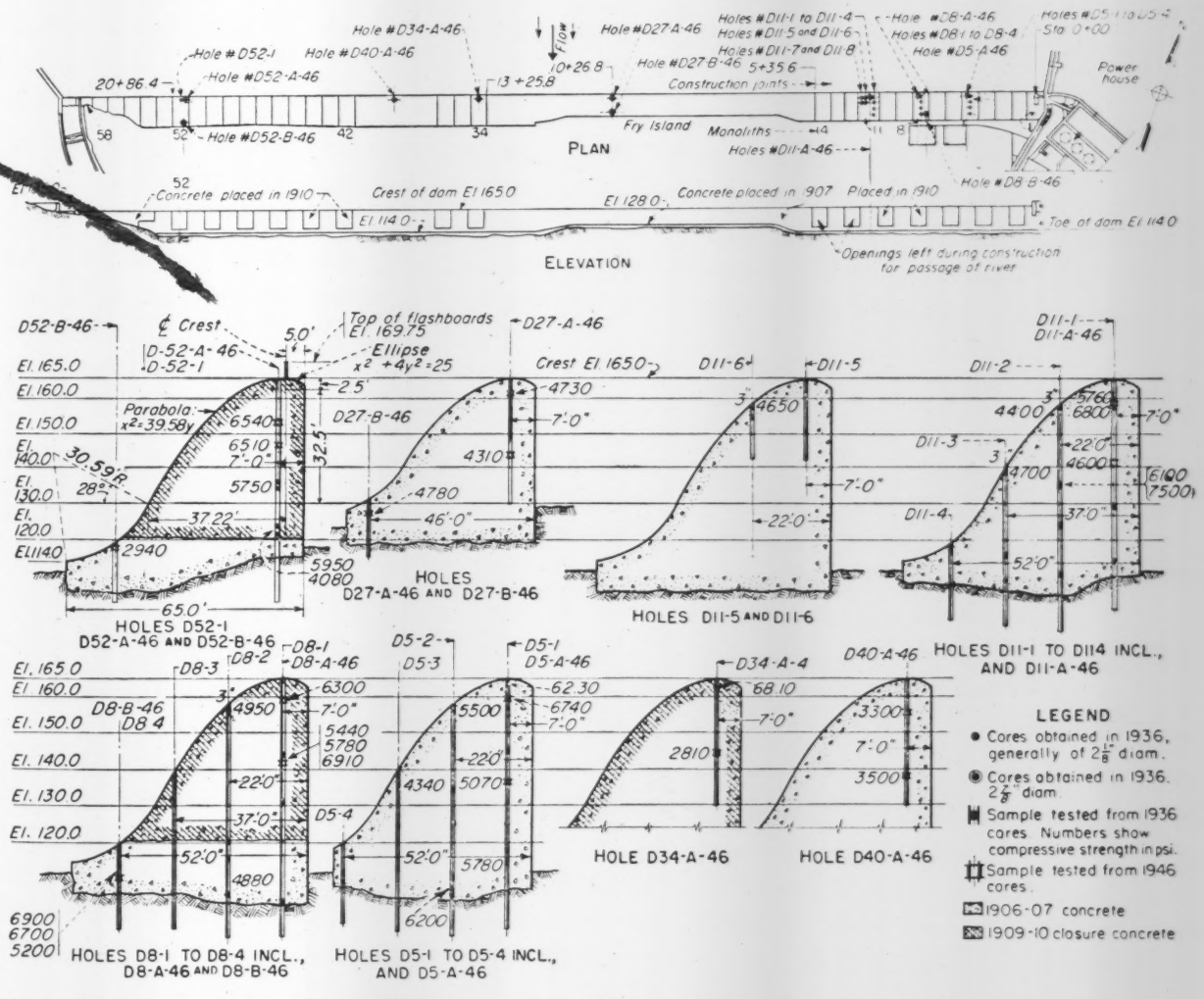

PLAN
ELEVATION
Concrete placed in 1910
Crest of dam El 165.0
Concrete placed in 1907
Placed in 1910
Toe of dam El 114.0
Openings left during construction for passage of river
Construction joints
Monoliths
Power house
Fry Island
HOLES D27-A-46 AND D27-B-46
HOLES D52-1 D52-A-46 AND D52-B-46
HOLES D11-5 AND D11-6
HOLES D11-1 TO D11-4 INCL., AND D11-A-46
HOLES D8-1 TO D8-4 INCL., D8-A-46 AND D8-B-46
HOLES D5-1 TO D5-4 INCL., AND D5-A-46
HOLE D34-A-46
HOLE D40-A-46
LEGEND
Cores obtained in 1936, generally of 2⅛ diam.
Cores obtained in 1936, 2⅝ diam.
Sample tested from 1936 cores. Numbers show compressive strength in psi.
Sample tested from 1946 cores.
1906-07 concrete
1909-10 closure concrete

Fig. 1. Compressive test data on cores taken from Holtwood Dam are shown on the dam sections to indicate exact source of specimens. Compressive strength of 40-yr. old concrete ranged from 2,810 to 7,500 psi. and averaged 5,368 psi.

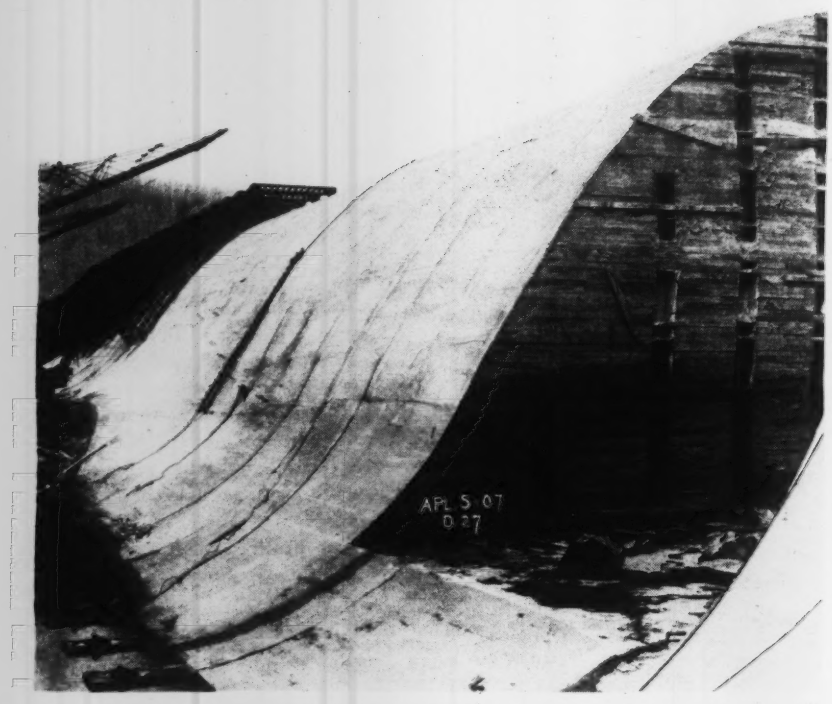


Fig. 2. Concrete was placed in alternate 40-ft. monoliths, with some of them left low to pass flood water during construction. Steel frames over the spillway section held the forms, and travelling, fixed-boom cranes, at left, placed the concrete.

Measurement at Holtwood Dam, *Civil Engineering*, July, 1938). These extracted cores were made available to the writer in 1946 for testing in connection with evaluating concrete in the structure. In 1946 a new series of 2¾ in. core holes was drilled to provide further data on the concrete. The location of both series of core holes and the position from which cylinders tested were taken is shown in Fig. 1.

Test data on concrete

The compression test values from the cores tested are shown on sections of the dam where they were taken rather than in tables, for ready comparison and to indicate the distribution throughout the structure of the test specimens. It will be noted that test values varied from 2,810 psi. to 7,500 psi. The average of all tests was 5,368 psi.

The values obtained were higher than anticipated prior to testing the cores. There are no available data regarding the 28-day test of this concrete as there is no record of test specimens taken during construction. Judging from laboratory test results made about the time this dam was constructed and the requirement of city codes of that period 1,500 psi. to 2,000 psi. would be the maximum 28-day compression strength expected with the cement available at that time. A search of technical literature failed to disclose long-time tests on concrete taken from similar structures, hence no comparison can be made regarding the test average.

Of importance in analyzing the test data is the material that went into the concrete and the methods used to place it.

Local cement and aggregates

Practically all the cement used in the concrete was shipped from plants in the Lehigh Valley region of Pennsylvania. Specifications required "All cement furnished under this contract should be pure Portland cement of the best quality, well and uniformly burned, and free from the presence of free lime or any other adulterating or foreign material."

The concrete technologist will note that the probable intent of this preamble is to obtain a stable product, as is still being sought today with the autoclave and other volume-change tests. Specification requirements were for a coarser-ground cement of lower early tensile strength than our present normal cements.

The sand was composed mainly of quartz grains and was obtained from a bank at Charlestown, Md. It probably was about the same quality as the commercial product of that area at the present time. The coarse aggregate was prepared from diabase (trap) rock and contained particles up to 5 in. in size. "Pudding stones", about 1 cu. yd. in size and from the same quarry as the coarse aggregate, formed about 20 percent of the total concrete yardage.

Concrete mix

Concrete of 1-3-5 volume proportioning was mixed in eight 1-cu. yd. mixers in a plant that *Engineering News* described as one of the largest and best such plants constructed to that time. The mixed product was dumped from individual mixers into 1¼-yd. two-line, bottom-dump buckets and hauled on flat cars to traveling derricks at the site of placing.

The water content of the mix could not be obtained from the available records, but it was reported that a sufficient amount of water was used at all times so that the concrete when deposited in place did not require tamping, and settled in its final position through the action of gravity. It was also stated that the material would quake when tramped on or jarred by train movement.

Exposure and erosion over the past 40 years have caused some wear on the surface. The large cakes of ice from the seasonal break-up, erosion from trash as well as exposure to freezing and thawing have worn the spillway face as shown in Fig. 3. Records show there has been a maximum surface wear of 7 in. with a general average wear near the apron of about 5 in. and an average over the entire spillway surface of 3 in.

As shown in Fig. 3 both the joints between monolith and the horizontal construction joints have a deeper wear than other parts of the surface, but no leakage has been observed through any joints. Original conditions during construction are shown in Fig. 2.

Based on concrete strength the structural rating of the dam after 40 years service is excellent and demonstrates the possibility of concrete as

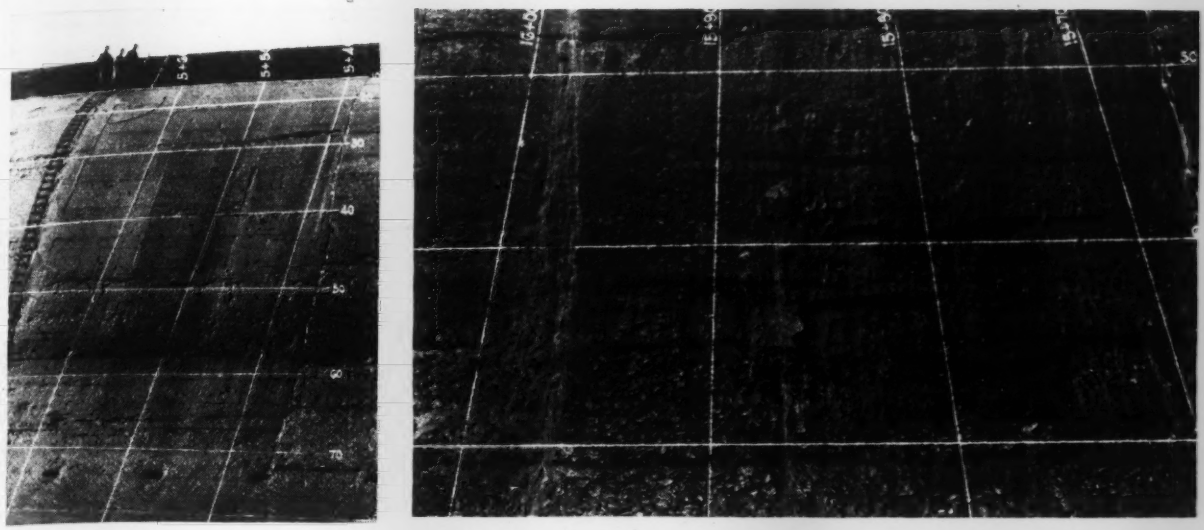


Fig. 3. Erosion, freezing and thawing have caused wear on the spillway averaging 3 in. Note resistance to wear of coarse aggregates exposed at right.

a structural material under severe exposure. The excellent quality of the concrete in this dam no doubt is largely due to the use of stable aggregates, selection of cement on the test basis, some regulation of the consistency of the mix and generally good methods of construction.

HISTORY OF McCALLS FERRY DAM

McCalls Ferry Dam, now known as Holtwood Dam, was one of the most interesting construction jobs of the early 1900's as is evidenced by the coverage given it in *ENR*'s predecessor journals. *Engineering News*, Sept. 12, 1907, devoted 11 pages (larger pages and with smaller type than at present) to the project. *Engineering Record* Sept. 21, 1907 and May 28, 1910 had a total of 14 pages on the structure and its construction.

Briefed from this voluminous record is the following, of special interest in connection with the tests on the old concrete.

The dam has a length of 2,350 ft. all of which was built as an uncontrolled ogee spillway section having a capacity of 671,000 cfs. It had 10 main waterpower units with a total installed capacity of 135,000 hp. at a 53 ft. head.

A first, and difficult, requirement for construction was access along the half-mile length of the dam, over rock swept generally clear by the swift river. This was attained by building a 2,300 ft. long construction bridge of concrete with arch spans alternating 32 and 40 ft. clear opening. The 40-ft. spans coincided with alternate monoliths of the dam to be left low to pass river during construction. The bridge was 50 ft. wide and was built in only 68 working days.

This bridge carried four standard gage railroad tracks and, at 44-ft. gage, tracks for travelling fixed-boom cranes. Three cranes were built for use along the spillway and two additional rigs for use in the power house construction.

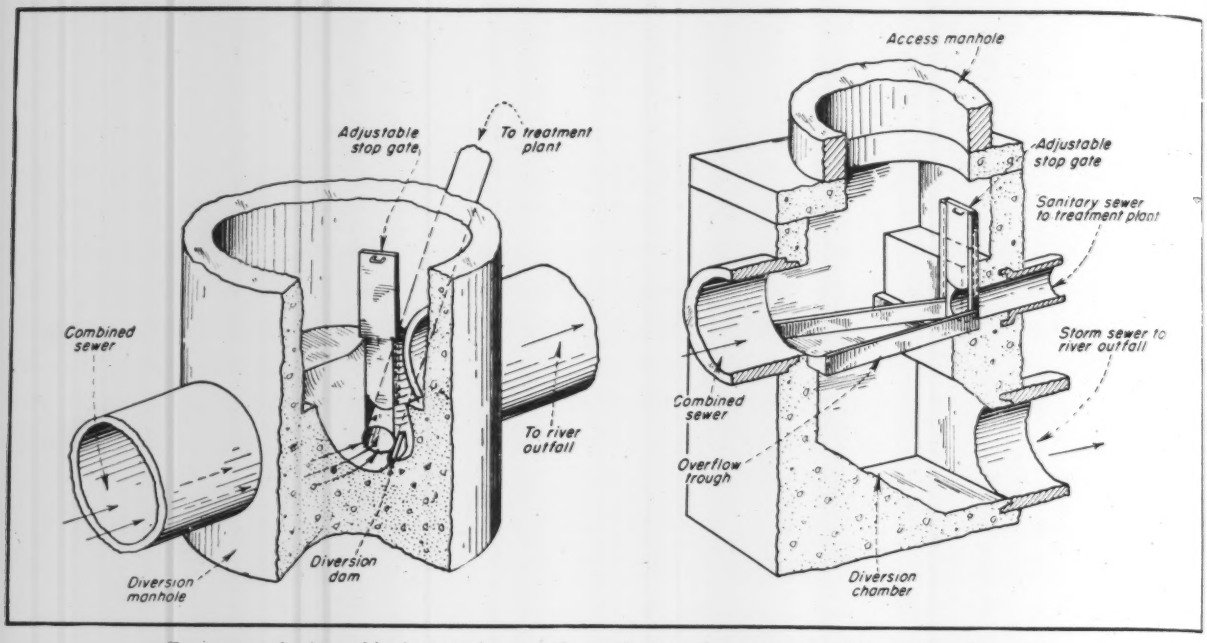
The cranes were designed to straddle the hauling tracks with a 40x16 ft. portal. Each had four outriggers with a horizontal reach of 94 ft. and a capacity of 5,000 lb. at the tip of the booms, which can be seen in Fig. 2. Separate power and controls for each of the four outriggers, at 10 ft. spacing, enabled each to be operated simultaneously and independently to place concrete, set pudding stones, handle forms and the like.

Up and downstream forms for the 40-ft. alternate monoliths were held by five structural steel frames at 10-ft. spacing. The frames were held by pin connections at their bottoms and worked as a rigid frame, having a sloping member along the downstream face, a horizontal top strut and a vertical member on the upstream side. A channel bent to the shape of the downstream face was held by the frame and it, in turn, held horizontally lagged wood panels.

The steel frames were spaced at 10 ft. centers, the same as the crane booms so that loads could be picked up from rail cars and passed through any of the openings without shifting the rig. The wood form panels were filled in as the concrete raised. Height of vertical lifts of concrete is not indicated in information available.

The concrete plant for the project had a continuous capacity of 240 cu.yd. per hour. Bottom-dump gondolas fed directly into bins having a capacity of 5,700 cu.yd. for stone and 1,100 cu.yd. of sand. Small batch cars with space for cement and volumetric measuring compartments for sand and gravel were loaded by gravity through air operated gates. The cars operated on narrow-gage rails to deliver the batch to a battery of eight steam-powered 1 cu.yd. mixers. Concrete was dumped from individual mixers into 1¼ cu.yd. two-line, bottom-dump buckets set on flat cars and hauled to the derricks at the site of placing.

The work was done under supervision of Cary T. Hutchinson and B. R. Value. Hugh Cooper and Wm. Barclay Parsons served as consultants. Total cost of the project was about $10,000,000.



Two types of adjustable devices that may be used to regulate sewage and storm flow diversion.

Diversion Factors for Combined Sewers Based on Sewage and Stream Analyses

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***Contents in Brief**—Up to the present time diversion factors for the discharge of sanitary and storm sewage from combined sewers to receiving streams have been chosen on a basis of opinion rather than calculation. In this article the authors describe a method of making such a determination by relating the organic load of the discharged sewage to the purifying power of the receiving stream. Such a study requires laboratory facilities and an extra expenditure for investigation. However, the benefits—cleaner streams and construction economies—may justify the added cost. In a forthcoming issue, a critical analysis of this method will appear.*

WHAT DIVERSION FACTOR should be used for non-polluting discharge of sanitary and storm sewage from a combined sewer into a receiving stream? To this question many answers have been given which indicate a wide divergence of opinion among sanitary engineers. Published design data from more than a dozen municipalities disclose that a range of diversion factors from 2.0 to 3.8 has been used.

Believing that the present system of selecting diversion factors arbitrarily should be supplanted by a scientific determination, Russell B. Moore, of Moore and Owen, suggested that the factor should be a function of the sewage entering a stream and the stream's ability to absorb that sewage without harmful pollution. In a recent study of the Indianapolis, Ind. system involving more than 100 diversion points, a method based on this suggestion was worked out in detail and applied to the design of interceptors and diversion works.

The writers believe that a description of the method developed will be of value and interest to engineers and look forward to critical discussion. Furthermore, it is hoped that this method will be applied elsewhere, and as a result, improved to cover the many variations that will arise from its use.

As is well-known, there are two types of sewers: sanitary and stormwater. The first type is used to collect and carry human and industrial wastes to a treatment plant or a point of safe disposal; the latter to intercept and convey surface runoff to a natural water course. When these functions are united in a single structure, the result is a combined sewer. In this, stormwater is present only during and

following rains or thaws, but sanitary sewage—variable in amount—flows continuously. Before sanitary sewage reaches the natural water course—the outlet for storm runoff, it is intercepted for conveyance to the treatment plant. The point at which this action takes place is called the diversion chamber.

A combined sewer operates quite simply when only dry-wheather flow is present; then the entire amount is diverted to the interceptor. During heavy rains the volume of stormwater is many times greater than that of sewage. As the stormwater contains sufficient oxygen to provide an excess above that demanded by the sanitary sewage, no serious load is imposed on the stream by the direct diversion of the combined flow.

On the other hand, during light rains a runoff might be contributed that, being nearly equal to the dry-weather flow, would create serious pollution if the diversion factor is inadequate.

Conditions may vary

In the past, designers have used a diluting volume several times that of the dry-weather flow so that no sanitary sewage or industrial waste enters the receiving stream until thoroughly diluted. Many objections to assuming an arbitary and uniform diversion factor stand out. The strength of the sewage varies in accordance with the density and character of the population served as well as with infiltration and industrial contributions; chemical and physical characteristics of the receiving streams change constantly; and the proportion of dry-weather sewage at one diversion chamber bears no relation to that at another.

The degree of required stream protection depends upon the use to which the stream is put, and the adoption, therefore, of an arbitrary, uniform factor for all diversion chambers does not provide a safe solution. Instead, pollutional conditions may arise below some outfalls and thus call for the use of over-size interceptors. Either of these conditions represents an economic loss to the community.

A rational method of determining the diversion factor consists of balancing the organic load of sewage against the purifying power of the stream. Such a balance is made at each outfall along the course of the receiving stream.

The organic load of the sewage equals its average five-day biochemical oxygen demand multiplied by the average dry-weather flow. The purifying power of the stream depends upon its volume of flow, deoxygenation and reaeration characteristics, BOD and DO content above the diversion chamber.

The average BOD is determined from samples taken just before the sewage enters the diversion chamber. These may be proportional composites of specimens taken hourly over a period of several days or weeks. The number required will depend on how critical the condition at the diversion chamber is and how much is already known about the characteristics of the sewage.

Average dry-weather flow in the sewer is obtained by means of a weir or a velocity meter with simultaneous determination of the fluid area. These measurements must be taken at the same time that samples are collected in order to properly relate volume to other characteristics.

Samples are collected

To evaluate the purifying power of the receiving stream, a series of samples is collected and analyzed for dissolved oxygen and 5-day BOD. Some samples are taken at points above the diversion chamber to determine the degree of pollution contributed by outside areas. Then, analytical results of the stream survey are modified to comply with the increase or decrease of pollution caused by altering diversion chambers.

Minimum stream flow is found either from measurements or gaging records. Then, from a study of the drainage area a quantity of surface runoff from a localized storm that will produce the most critical flow in the sewer system is calculated and added to the minimum stream discharge. The critical flow is defined as that which results in the greatest organic load being spilled into the stream when the diluting water is a minimum. This condition lies between the dry-weather status when the entire flow goes into the interceptor and a heavy storm period when the stream receives all the sewage with ample dilution.

Deoxygenation and reaeration characteristics of the receiving stream are calculated by making use of its biochemical oxygen demand, dissolved oxygen, temperature, and deoxygenation and reaeration constants.

A complete combined system has diversion chambers at the lower end of each combined sewer, all located on the interceptor running parallel to the receiving stream. Since all chambers deliver sewage to the same stream, the system is analyzed first

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Method of Application Based on Maximum Sewage Load

$$D_t = \frac{L \times K_1}{K_2 - K_1}\left[10^{-K_1 t} - 10^{-K_2 t}\right] + D_0 \times 10^{-K_2 t}$$

is used in which

D_t = Dissolved oxygen deficit below saturation after a period of t days, ppm.

L = Initial BOD in stream, ppm.

K_1 = Deoxygenation constant = 0.10

K_2 = Reaeration constant = 0.24

D_0 = Initial dissolved oxygen deficit in stream, ppm.

t = 2 days

DO saturation at 20 deg. C = 9.17 ppm.
Therefore, D_0 = 9.17 − 7.17 = 2.00 ppm.

Minimum DO permitted = 0.50 × 9.17 = 4.59 ppm. Substituting in formula—

$$4.59 = \frac{L \times 0.10}{0.24 - 0.10}\left[10^{-(0.10 \times 2)} - 10^{-(0.24 \times 2)}\right] \times 2.0^{-(0.24 \times 2)}$$

from which

L = 18.4 ppm.

Then BOD can be contributed by sewage in combined sewer = 18.4 − 2.0 = 16.4 ppm.

DIVERSION FACTOR

BOD in sewer = 20.2 × 8.34 × 264 = 44,500 lb.

Total flow in stream = 60 + 100 + 100 = 260 mgd

Total BOD stream can accept safely = 260 × 16.4 × 8.34 = 35,500 lb.

BOD that must be diverted to interceptor = 44,500 − 35,500 = 9,000 lb.

Then, the percentage diverted to interceptor $= \frac{9{,}000}{44{,}500} = 20.2\%$

Flow in sewer (dry weather plus storm) = 20.2 + 100.0 = 120.2 mgd

Since 20.2% must go to the interceptor—the quantity to be diverted = 0.202 × 120.2 = 24.3 mgd

Then the diversion factor $= \frac{\text{flow diverted to interceptor}}{\text{dry weather flow}} = \frac{24.3}{20.2} = 1.20$

Note: This factor applies only for a storm runoff of 100 mgd.

as if only one diversion point existed. After the overall diversion factor has been computed, it is modified for application to each unit.

How method is applied

To illustrate use of the method and thereby clarify its theory, a typical example is shown in the accompanying box. In it the following assumptions and facts govern:

1—A combined system and interceptor are being revised.

2—The minimum flow in the stream is 60 mgd.

3—The drainage area analysis indicates that 50 percent of a storm runoff will reach the stream through the sewer system and 50 percent by surface travel. For the first trial, 100 mgd. is used for each value.

4—The stream is used for fishing.

5—The state health department requires a minimum dissolved oxygen content of 50 percent of saturation.

6—The maximum stream temperature is 20 deg. C.

7—For the type of stream the deoxygenation and reaeration constants are 0.10 and 0.24 respectively (U. S. Public Health Service, *Bull* No. 146 and 173).

8—The stream survey shows a BOD of 2 ppm. and dissolved oxygen of 7.17 ppm.

9—The storm water contains the same values as given under item 8.

10—The diversion factor solution is a trial-and-error process.

11—The critical condition will be represented by the maximum diversion factor.

12—The total dry-weather flow of sanitary sewage which may go into the stream is 20.2 mgd.

13—The weighted average of sewage BOD is 264 ppm.

The diversion factor for a storm discharge in the sewer of 100 mgd. is found to be 1.20. It is now necessary to recalculate the factor for other storms: the flow giving the highest value represents the critical condition.

As the maximum diversion factor is approached by successive trails, the amount of storm flow that will go into the interceptor must be estimated and subtracted from storm runoff going to the river directly. In the example, further solutions show the maximum diversion factor to be 2.02 when 60 mgd. of storm flow enters the sewer.

Individual factors for each chamber are found by multiplying the general diversion factor by the ratio of BOD in parts per million at each chamber to the weighted average of BOD (ppm.) of all the sewage in the system. In this way, a mixture of stormwater and sewage overflowing to the stream at one chamber will be exactly of the same concentration as overflow at any other point. While the overflow will vary at each outlet during a storm, the stream will be loaded to its safe limit only at the lower end of the interceptor under normal conditions.

Advantages outlined

Several advantages accrue from the use of this design method: The stream is never permitted to become polluted to the point where dissolved oxygen falls below the safe limit; and the diversion factor is developed for the worst rainfall condition. Moreover, with an increase or decrease in precipitation, this condition is passed quickly and improvement takes place in either direction.

Only at infrequent intervals and then for only a short period will a low oxygen content be found in the stream. Use of a high, arbitrarily-chosen diversion factor does not guarantee a safe oxygen condition. In a large city recently studied, it was found that factors should range from 1½ to 10. If a factor of 5 had been applied universally, pollution at points where sewage was especially strong would not have been prevented.

Another advantage is that more economical designs are obtained. For moderate-size streams, a diversion factor of three would have been a typical value to use in the case mentioned. Actually, the weighted average came out to be 2.2—a 27 percent saving in the interceptor capacity that represented several million dollars.

Again, various sections of a city are treated with equity by insuring that streams in various neighborhoods are exactly in the same sanitary condition. No city has money enough to remove pollution absolutely from streams, but the maximum good is received from each sewer dollar when stream conditions are equalized.

Suggestions for chamber design

Diversion chambers should be designed with a means of adjusting the overflow so that changes in population can be accommodated. Moreover, ample capacity for population increases should be provided in interceptor design. In no case should a factor of less than 1½ be used. Then raw sewage will not be dumped into the stream during dry weather and the interceptor will take the first flush of the combined sewer during a storm.

The method may be applied to the design of new systems by estimating carefully the sewage strength and quantity in each area. Later, factors can be adjusted to meet requirements determined from actual tests.

Many cities with combined sewers could redesign their diversion chambers and interceptors on the basis of this method at a small cost. Moreover, conditions in the receiving streams might be improved so that costly improvements or new treatment plants could be postponed for several years.

Critical comment and discussion of this method by a group of sanitary engineers will be presented in a future issue.

New Standards For Perforated Pipe

A new standard for perforated clay pipe has been accepted by the manufacturers of such pipe, according to the U. S. Bureau of Standards. The design for this new standard is based on war experience of the Corps of Engineers, U. S. Army, and some of the state highway departments. The pipe has smaller holes, which are scientifically placed to reduce the infiltration of fine material.

The perforations are circular and cleanly cut, ¼ in. in diameter, arranged in parallel rows about 3 in. center to center except in the bell and spigot of the pipe, where there are no holes. Four rows are used in the 4, 6 and 8-in. pipe; six rows in 10, 12 and 15-in. pipe; and eight rows in 18, 21 and 24-in. pipe.

The lowermost row in each group is separated from the corresponding row on the opposite side of the pipe by an arc of 90 deg. measured around the pipe, and the uppermost rows are separated by an arc of 200 deg. measured over the top.

The new perforated pipe comes in both standard and extra-strength grades. Its designation is CS143-47. The pipe is identical with ASTM designations C13 and C200 with addition of requirements for perforations.

When tested by the sand-bearing method the standard 4, 6 and 8-in. perforated pipe has a minimum strength of 1,430 lb. per lin.ft. and the extra-strength pipe has a minimum of 2,850 lb.

RESEARCH LABORATORIES OF THE RECLAMATION BUREAU—PART VI

Looking Ahead To New Developments

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***Editor's Note**—This is the final article of a series setting forth the philosophy, the accomplishments and some of the future objectives of the research laboratories maintained by the Bureau of Reclamation. In this last installment discussion is centered on developments pointing to more durable concrete, better cement, improved paints, new techniques for testing materials and cavitation-free hydraulic structures. First article of the series appeared in the Sept. 18 issue, vol p. 381.*

IMPROVED engineering practice through research is a reasonable expectation. Certain it is that opportunities for improvement are not lacking. It is with these opportunities that the staff of the Bureau of Reclamation research laboratories finds a significant challenge.

Concrete mixers, as an example, do not mix their batches efficiently in a reasonable minimum period and equipment for placing and compacting concrete still leaves much to be desired. Again, in the compaction of earthwork, roller tampers were recognized as progressive pieces of equipment when they first appeared but it is now evident that by vibration methods, quite dry earth may be more satisfactorily consolidated. A few short years ago we strove to obtain dense concrete (without air voids); now we purposely put air into it.

It is apparent that many of our present engineering concepts and orthodox methods may be altered for greater progress through the instrumentality of laboratory research.

More durable concrete

While our knowledge concerning the art of making high-quality concrete has advanced greatly during the last decade, and our ability to produce lasting concrete structures has improved with such added knowledge, the durability of much well-made concrete is still somewhat unpredictable. After all care has been taken in selecting the ingredients and after preparing and placing the concrete under acceptable procedures, a structure may, within a few years, exhibit disappointing resistance to the elements and show evidence of crumbling under repeated alternations of freezing and thawing.

This problem has been vigorously attacked by the Bureau of Reclamation laboratories with assuring results. They have confirmed the fact that minute bubbles of air in the concrete, entrained during the mixing operation by the addition of agents which produce a foam, make the concrete much more durable. Although discoveries of this nature have provided an excellent remedy for a serious problem, satisfactory explanation of the reasons for the results are lacking. If the processes were thoroughly understood, better methods might suggest themselves.

There is a demand, therefore, that intensive study be made of the mechanics of the processes by which the elements destroy concrete. Basic information is needed on how water enters and migrates through the concrete; how it freezes in the pores of the concrete; what pressures or forces are created by the freezing water, and whether the structure of the concrete can be altered to resist such forces or to prevent their occurrence. These are some of the questions that need to be studied by trained and experienced scientists, whose efforts should

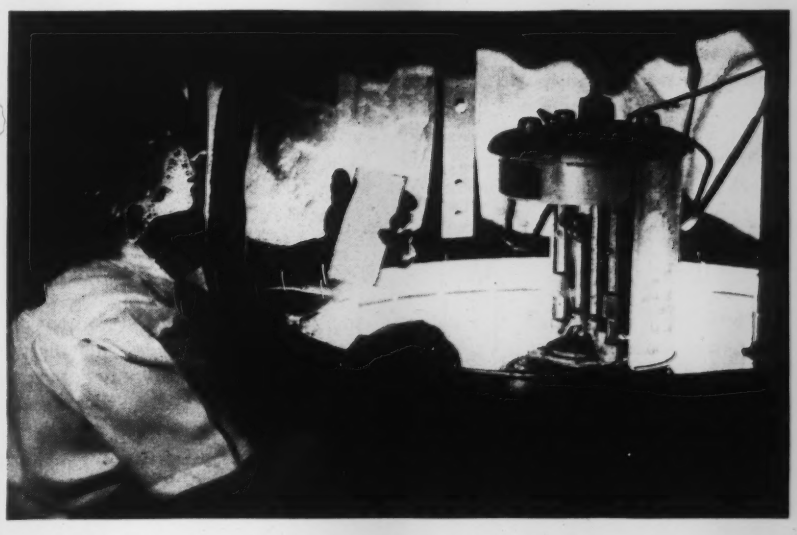


Fig. 1. Rapid testing of construction materials under conditions that closely simulate actual conditions of service is an essential laboratory procedure. Above is an accelerated weathering machine to determine resistance of various types of paint to sunlight and rain.

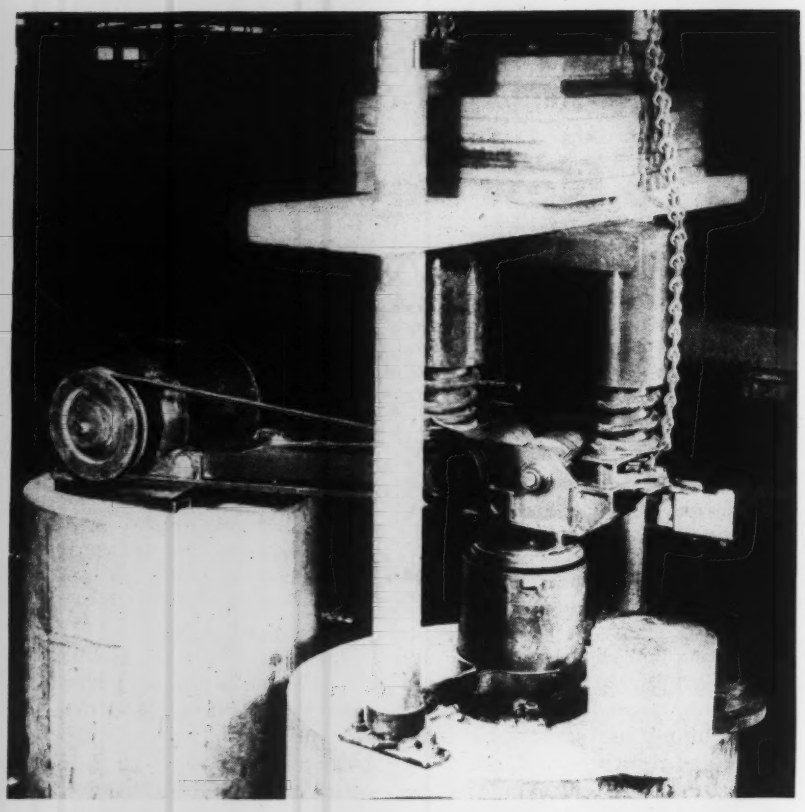


Fig. 3. Compaction of soil by means of high frequency impacts is currently under study utilizing this equipment developed by the Barber-Greene Co. Eccentric weights driven in opposite directions at high speed are combined with a spring-supported load to develop exceptional compactive forces.

be devoted exclusively to such research.

Portland cement is an excellent building material: nevertheless, like all other materials used in construction, it has its defects. It generates considerable heat during setting, which causes troublesome volume changes in the concrete. Concrete made with it swells when wetted and shrinks and cracks as it dries. It is attacked by chemically aggressive waters and is slowly dissolved by pure water. It expands under rising temperature and contracts as the temperature falls. Concrete made with some cements unexplainably exhibits premature stiffening, and is very difficult to handle and place.

Although such deficiencies are not always as pronounced as the previous indictment may imply, they are nevertheless serious. They give rise to many complicated structural design problems and often lead to considerable maintenance costs. Significant progress in the improvement of portland cement has been made in the last decade. A low-heat cement has been developed, which materially reduces the heat generated during setting. However, there are indications that portland cement may be improved even further with respect to heat generation, and that research of a basic character on this subject will be fruitful. By controlling the cooling of the cement clinker, it appears possible to produce a cement of even lower heat generation.

The National Bureau of Standards, the Portland Cement Association, and manufacturers of cement have conducted noteworthy research on the constitution of portland cement and its hydration products, but there is yet only a lamentably small percentage of data on which authorities can agree. The manner of hydration and nature of the hydration products are still very obscure. Before those qualities in which portland cement is deficient can be improved, it appears that we must obtain more basic information.

The chemist, petrographer, microscopist and physicist, if given funds and the latest scientific tools, can supply information, without which engineering progress on cement appears stymied. Unexplained differences observed in the qualities of various cements, all practically identical as judged by chemical analyses and fineness, show that a fertile field for research exists, and offers promise that intensive study may show how to duplicate only the better products in the future.

Toward better concrete

Deterioration in a great many structures has been traced to expansion caused by reaction between some constituents of the aggregate and cement of high alkali content. Where such reactive aggregates could not be avoided, it has been considered necessary to insist on low-alkali cement. Latest data from researches suggests that a better means for insuring sound concrete with this type of aggregate is the use of portland-pozzolan cement.

Some highly active siliceous materials added to the concrete in a finely ground state, or interground with the portland cement, have been demonstrated to inhibit the expansive deterioration occurring with reactive aggregate even though high-alkali cement is used. For this reason, the Bureau of Reclamation has determined to use a pulverized calcined reactive siliceous material in the concrete for Davis Dam, being built on the lower Colorado River, upstream from Parker Dam; it will be recalled that the latter structure is suffering from the expansive reaction between active aggregate and high-alkali cement (*ENR* Mar. 27, 1941, vol. p. 462).

For future concrete work in areas where reactive aggregates are prevalent, it would be advantageous if such inhibitive material were incorporated in cement, avoiding the batching of a separate ingredient. It may be predicted that portland-pozzolan cements, containing proven active siliceous additions, in addition to providing an answer to the problem of manufacturing sound concrete with reactive aggregates, will some day become popular for general purpose use. Their resistance to seawater and sulfate attack are already well established, and the slow rate of heat gen-

eration and extensibility found for them adapt them admirably for massive construction.

Improved paints and coatings

Plastics is a broad term that takes in a wide variety of synthetic resin materials. Some that are soluble in organic solvents are already used extensively as basic ingredients in paints. Certain others are so inert to all solvents and chemicals that they cannot be made into liquid coatings. The latter, of course, would be expected to provide the ultimate in permanent protection against corrosion for ferrous metalwork, if a satisfactory method of applying them can be found.

Showing promise is a flame-spraying method. Powdered plastic is fed into an oxy-acetylene flame and blown onto the surface in a molten state. It is visualized that if certain difficulties in obtaining bond and avoiding degradation of the plastic can be overcome, we may have the long-sought "perfect" coating. Known already is the fact that certain of these plastics hold up remarkably well in comparison with conventional coatings under the disintegrative action of cavitational flow. New testing equipment for evaluating this property of the "coating of tomorrow" is shown in an accompanying illustration.

Waterproofing the upstream face of old concrete and masonry dams has been a problem for years. Pneumatically applied mortar is somewhat porous; and lacking flexibility, it has poor resistance to cracking. Bituminous coatings are abraded by ice and debris. Metal facings are very expensive and subject to corrosion unless even more expensive corrosion-resistant metal is used. The ideal coating would be tightly adherent, have flexibility to bridge small cracks, would be impervious of course, and would be practically unaffected by exposure to water and sunlight. The answer is very likely to be found in some of the synthetic rubber compounds, such as Neoprene or Thiokol.

Cathodic protection is gaining wider application every day. How simple it would be if we could permanently and completely stop corrosion of all submerged and buried ferrous metalwork by this means. Buried pipe and the inside surface of water tanks are now being protected in this way. It is reasonable, therefore that means may be developed to apply this principle to trashrack structures, submerged gate surfaces, and also penstocks, although there are practical difficulties facing such application at the moment.

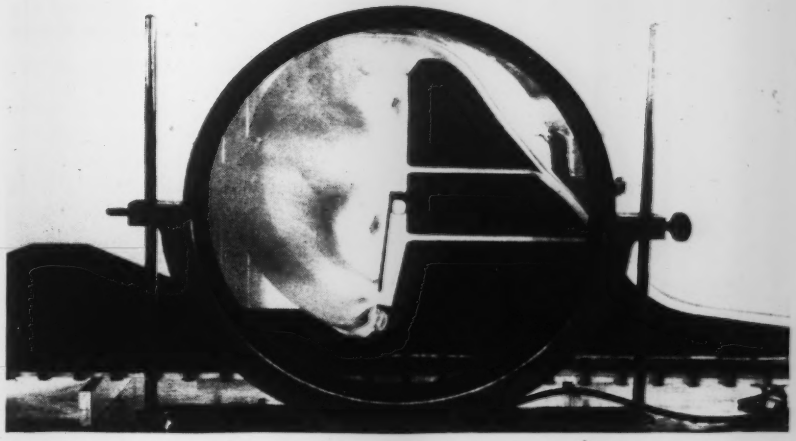


Fig. 4. Discharge of sediment-carrying currents through sluiceways in dams is being studied. Here is a laboratory set-up for determining flow patterns with the aid of polarized light on a water suspension of bentonite. The intake of the lower outlet penstock is masked by a hood structure to insure scouring of the slit pocket at the heel of the dam.

New techniques for testing

The application of X-ray diffraction methods and techniques may prove useful in solving many engineering problems. The identification of reactive minerals in aggregate; recognition of unsound interstitial clay minerals in aggregate, or in foundation rock; determination of thin films and the size of submicroscope particles; studies of residual strains in welded metal and of the recrystallization of fatigued metal; these are typical problems on which the X-ray may unquestionably be applied.

New techniques must be devised through research that will permit rapid testing of construction materials under conditions that closely simulate actual conditions of service. Developmental research, therefore, must be directed toward a determination of the inherent characteristics of materials that control their serviceability.

For example, it becomes necessary to know what structural, mineralogical and textural characteristics of riprap govern its resistance to wave action, wetting and drying and freezing and thawing, in order to develop tests capable of predicting the durability of this construction material. Studies on earth materials, particularly the clay constituents, will yield new insight on their behavior and permit development of tests which will give engineers greater assurance where foundations involve these materials. The instability of saturated clays under load may contribute to structural failure, but also the swelling characteristics of certain bentonitic clays may cause significant disruptions. More reliable methods of predicting the quantitative characteristics of these earth materials must be devised so that engineers may appropriately design their structures to meet adverse environmental conditions.

Studies on sedimentation

The problems of sedimentation are rapidly becoming more important in the development of irrigation projects, and in the future will receive major attention. The science of sediment engineering has been very largely developed in the last fifteen years and is only now, after a period of suspension due to the war, beginning again to make progress.

The laws governing the transportation of sediment in the various forms in which it moves have only partially been worked out, and as these are fundamental to many problems encountered, considerable effort will be made toward defining them. Constructing irrigation ditches so that they will neither scour nor fill with sediment is one of the problems which

is partly solved. Further study is needed before designs can be prepared which are sure to be satisfactory without being unduly conservative.

Desilting works for irrigation ditches will be frequently constructed, and studies are contemplated with the objective of preparing designs to take advantage of the most recent developments in this field. The laws governing the degradation of stream channels below dams due to cutting off the flow of sediment along the stream bed are already under investigation, and the application of this phenomenon to relieve the clogged condition of some stream channels (such as the Lower Rio Grande) is being given serious study.

The possibility of reducing the rate of silting of reservoirs, by discharging the density currents which bring sediment down to the dams, is being studied. Designs, incorporating sluices to discharge this sediment, without using gates under excessively high heads, have been considered for one dam, as shown in Fig 4.

Compaction methods under study

During the war the Germans were compacting embankments and gun emplacements by new methods, possibly employing vibration. Simultaneously in this country, experiments were being conducted to explore the possibilities of consolidating earth by the application of vibration. Pilot tests have proved very encouraging. However, real problems are presented in the development of practical equipment for applying this principle on the job.

Laboratory apparatus for studying the effects of impacts delivered to soil at high frequency has been built. To supply the compacting blows a pair of eccentric weights is used. They are revolved at high speeds in opposite directions so that their centrifugal forces cancel each other in a horizontal plane but implement each other in a vertical direction. A compaction plate, which is actuated by the eccentrics, is kept in contact with the soil by weights supported on springs.

Remarkably high densities, on relatively dry soil samples, have been secured in phenomenal short time with this equipment, and it is possible that such a device may be used for compacting dry portland cement concrete, asphaltic concrete or soil-cement mixtures.

Cavitation-free hydraulic structures

Although acceptance by the engineering profession of the present-day theory concerning the nature of cavitation has taken place mainly within the past decade, the term itself is not a new one. For many years, engineers have viewed with apprehension the pitting or erosion of surfaces resulting from cavitation in hydraulic structures. Many attempts were made to prevent, eliminate, or resist it, but little success was realized until general application was made of the present theory of cavitation action, any study of which involves the investigation of sub-atmospheric pressure conditions.

The development of cavitation-free hydraulic structures, whether of an open-channel or a closed-conduit nature, has kept pace with this advancement. Gates, valves, siphons, large outlet conduits, gate grooves, and spillway crests are among the many cavitation-free structures developed by the Bureau of Reclamation.

Designs for these structures were based upon data obtained from scale models in which numerous pressure-recording connections were installed. The data obtained were expressed in terms of the full-sized structure by similitude relationships, with the criterion of design being the elimination of sub-atmospheric pressures or the reduction of such pressures to a minimum. Such a criterion is conservative, particularly if one considers that cavitation is not supposed to occur until the pressure of some point in the flow passage is equal to the vapor tension (special condition of vapor pressure where an abundance of the fluid is present) of the fluid, about 0.5 psi (absolute pressure) for water. In many cases, a less conservative criterion, such as permitting the pressures within the structure to approach as near the vapor tension as possible without producing cavitation, would result in a more economical and efficient structure.

A comparatively new method of testing in the hydraulic field has resulted from the desire of designers to attain these results. The test facility, known as a water tunnel, enables operation of models under reduced pressure, such that the action obtained is essentially that which will occur on the full-sized structure. If under these conditions there is no damaging action on the model, it is logical to conclude that there will be none on the large structure.

The water tunnel may be used to advantage also in making studies of existing structures where the pressure distribution is of concern and cavitation is present. The popularity of this facility is ever increasing, and the laboratories of many universities, private concerns, and other federal agencies are either acquiring it or revising their present equipment to meet the demand for information regarding the cavitation phenomenon. The engineering profession is looking forward to designs and design criteria which are certain to evolve from the extensive use of this test facility.

What the future holds

In this brief recital of opportunities for improved engineering practice we have set forth some of the things that command attention in the present and future programs of activity for the Bureau of Reclamation research laboratories. On the basis of past experience, as outlined in previous articles of this series, we feel confident that equally fruitful progress will be made on those problems with which we are now challenged.

We know that our engineering projects are annually becoming more complex and difficult, and call for more specialized treatment, research and investigation. The more difficult sites and natural conditions of our future engineering works demand closer and more intensive study of design, more careful attention to construction control, and guided procedures. These factors forecast increasing specialization and more thorough study of our planning design, construction and operating problems as time goes on.

It is the function of an alert research organization to keep abreast of all scientific developments and to find application for new facts, new materials and processes. It applies special knowledge and techniques to the solution of practical problems arising in the course of engineering design and construction. However, its best service can be rendered by exploring the expanding fund of basic scientific data for practical applications which transform this knowledge into action.

Fig. 1. Stone chips on surface-treated gravel shoulders delineate the asphaltic concrete pavement of the Maine Turnpike.

Building the Maine Turnpike

***Contents in Brief**—In the past 18 months, 7,000,000 cu. yd. of earth and rock were moved and 43 bridges built, while during 6 months of this year some half-million tons of hot asphaltic concrete were laid to complete the 47-mile Maine Turnpike from Kittery to Portland. A frost-free subgrade—3 ft. of well compacted granular material—provides firm support for two base courses totaling 5 or 6 in. thick and a 2 in. top. Aggregates were produced along the road and mixed through four portable plants, one of which was a dual-continuous outfit with a capacity of 200 tons per hour.*

SAID TO BE the greatest yardage of asphaltic concrete ever placed on one job in a single season, 1,360,000 sq. yd. of high type hot-mix, hot-laid pavement was placed this year on the Maine Turnpike. Maximum daily output exceeded 6,500 tons with weekly averages over 30,000 tons. This was laid in three courses, having a total depth of 7 or 8 in. over carefully placed supporting material.

The Maine Turnpike is being built as a self-liquidating toll road financed privately through the Maine Turnpike Authority, an agency of the state. No federal or state funds of any kind are being used, nor is the state's credit pledged to support bonds sold by the authority to finance construction (*ENR*, Jan. 23, 1947, vol. p. 147).

Construction of a road from Kittery on the Maine-New Hampshire border to the Canadian border in such units as would be self-liquidating is authorized under a legislative act creating the Maine Turnpike Authority. The first section undertaken is the 47-mile Kittery-Portland link, paralleling the heavily travelled, inadequate U. S. Route 1. This section is financed by $15,000,000 of bonds issued in February, 1946, and bearing 2½ percent interest, supplemented by an additional $5,000,000 of bonds at 2¾ percent interest, sold this year. Extension of the turnpike will depend on use and income of the section now being completed.

Contracts for grading and construction of minor structures for this 47-mile section were let in May, 1946, and some 20 miles of grading was completed last season. Contracts were awarded for the paving about a year ago, but that work did not get under way until May 15 of this year. With borrowed funds drawing interest, it was desirable that the work be completed to an income producing stage this season, hence contracts were explicit on that point. Paving was essentially completed in October with shoulder work not far behind. The construction bottleneck was bridges, where late delivery of steel delayed the deck construction into the late fall months but opening is planned for Dec. 1, only a month behind the original schedule date.

The road is a limited-access dual highway with two 24-ft. lanes separated by a constant width of 26 ft. The central 18 ft. of the median area is a raised, seeded strip, while 4 ft. on each side, adjacent to the pavement, is an asphalt treated gravel shoulder. The pavement has a 2-in. crown at the center to produce drainage both ways and reduce the formation of ice on the pavement. Under-drains are provided along each side of the median area. On the outside of the dual lanes of pavement an 8-ft. shoulder provides space for disabled cars.

Maximum curvature on the turn-

Fig. 2. Some 200 tons per hour of crushed gravel were produced in this two-unit portable crushing and screening plant used to supply base-course aggregate.

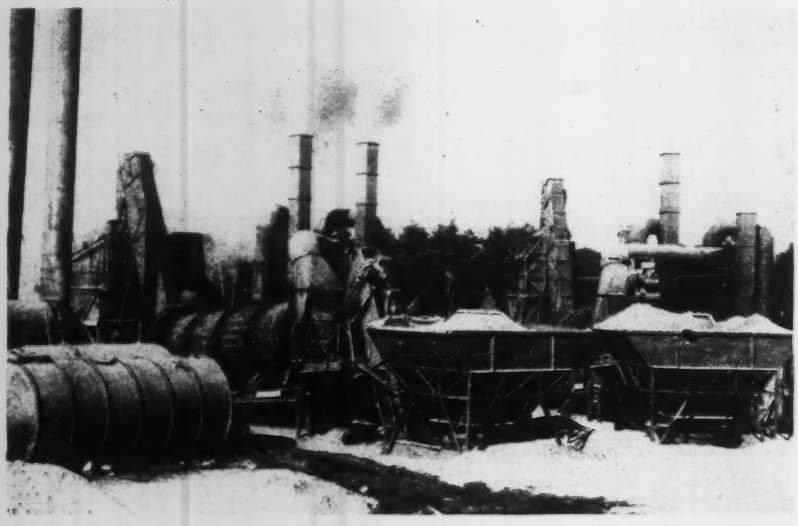


Fig. 3. Twin continuous mixing plant supplied base-course asphaltic concrete to the south half of the Turnpike.

pike is one degree and the maximum grade is 4 percent. The vertical sight distance is 525 ft. from a position 4.5 ft. above the roadway to an object 4 in. high on the road surface. The road is designed for a maximum safe speed 60 to 65 mph. A speed limit of 60 mph. has been set by the Maine Turnpike Authority.

The essential part of moving some 7,000,000 cu. yd. of earth has been to provide an unyielding base for a flexible type pavement. Fill material was dumped in 9-in. layers and compacted with sheepsfoot or rubber-tired rollers to 95 percent of maximum density at optimum moisture content.

To prevent harmful frost action under the pavement, 30 to 42 in. of free-draining granular material was called for as a subgrade. It was specified that not more than 10 percent of this material should pass a 200-mesh screen and that it should be compacted to 95 percent of maximum density.

Along 30 miles of the 47-mile length of the turnpike, material that compacted readily was available so that hauling trucks and asphalt spreaders could operate on the subgrade without disturbing the surface. However, on a 7-mile length the locally available permeable material was sand with a very uniform grain size, which made necessary the use of large quantities of water to secure compaction. On grades, the amount of wetting, rolling and manipulation to secure compaction made use of the local sand uneconomical. The solution found was to grade the sand surface to below the final elevation and add 2 or 3 in. of crushed gravel, with fines, to make essentially a water-bound base. On the remaining 10 miles of the turnpike the economical solution was to leave the permeable matter about 6 in. low and haul in gravelly material that would compact.

Asphaltic concrete pavement

Hot-mix, hot-laid asphaltic concrete was selected for the paving after an analysis of bids taken on both concrete and black top indicated that the latter, in the opinion of the Maine Turnpike Authority, would be the best investment. Asphaltic concrete has had a long record of good service in this area where sleet and ice conditions are quite severe and where use of chlorides is common. In addition, the black surface absorbs considerable heat from the sun, thus helping to keep the surface ice-free.

On the basis of an average of 7½ in. total depth of asphalt compared to 8 in. that would have been used for concrete, there was a substantial saving in first cost of asphaltic concrete over portland-cement concrete, which was a definite consideration in the selection of the paving type. Over areas where material of excellent bearing quality was available, the base was made 5 in. thick, placed in 2½-in. layers. Where it was difficult to quickly stabilize the subgrade, 6 in. of asphalt was laid in two 3 in. layers. The top-course mix is uniformly 2 in. thick.

The mix designed for the road was of a type that is relatively open when placed but which closes up under traffic to give a watertight but nonskid surface. Crushed gravel as large as 2 in. was used in the base course, with 4.7 percent asphalt. A crushed stone with as much as 40 percent of the material between ⅜ and ¾ in. size was used for the 2-in. top surface, with 6 percent asphalt. All asphaltic cement was 85-100 penetration.

Placing the paving was let in two approximately equal sections for the north and south halves of the turnpike. B. Perini & Sons were low on

both sections but sublet most of the north portion of the work to Gibbons & Reed. Each organization set up two hot-mix plants along its section of the paving and each produced its own aggregates. But, because of natural conditions, the plant layouts and planning were substantially different.

On the south section of the road where Perini did the construction, separate plants were set up for base and for top mix at about the center of the haul distance.

An excellent bank of material suitable for base-course aggregates was found just off the turnpike. Here, a three-unit portable crushing and screening plant was set up to supply 200 tons per hour of crushed and screened gravel. This plant consisted of a bar grizzly, feeding via a conveyor to a 10x36 in. jaw crusher and 40x24-in. roll crusher. Additional conveyors carried the material to screens and to loading bins.

Mixed aggregate was trucked only a short distance to a dual continuous-mix plant with two complete units set side by side to feed into a common hopper for truck loading. Sand for fines came from a nearby natural bank and one crane fed two-compartment hoppers that directed material to the cold elevators of each plant, which in turn fed into oil-fired drum driers. A hot elevator carried the material to a sizing screen where aggregates were separated into four sizes for recombining into the design mix. Measured quantities of material were again raised by elevator to the pug-mill where metered bitumen was added and materials mixed in a continuous stream, which discharged into a truck loading hopper. This twin plant turned out upward of 200 tons per hour of asphaltic concrete with gravel aggregate, used exclusively for base construction.

Fig. 4. Two pavers worked together to lay two 12-ft. lanes of 3-in. thick asphaltic concrete on a wetted and compacted subgrade.

Fig. 5. For the second course pavers laid one 13-ft. and one 11-ft. lane to eliminate what might be a line of weakness along the center.

Stone aggregate for top course

Wear resistant crushed stone was specified for coarse aggregate of the top course and was found in an easily developed quarry along the turnpike, some two miles from the gravel pit. The stone is very hard with a wear coefficient of about 17 percent compared to 29 percent for the crushed gravel used in the base course.

There was little overburden at the quarry, which was worked from one face using wagon drills on top to prepare for blasting. Two jaw crushers, a gyratory and a roll crusher, were used to process rock, which was divided into three sizes for delivery to a batch-type asphalt mixing plant a quarter-mile distant. Additional sand from a nearby bank was used to make up the deficiency of fines—45 percent of the aggregates used for the surface course being required to pass the $\frac{1}{8}$ in. screen.

A crane fed the aggregates into a hopper at the mixing plant, from which it was rough-batched into the dryer drum, then routed to separating screens and via a hot elevator into a four-compartment bin above a 4,000-lb. weigh batcher. The aggregates with six percent of asphalt were weighed into a pugmill, mixed as a batch, and then dumped into trucks for haul to the road.

Perini used two black-top paver-finishing machines on base course. Pavers usually worked a day or two on the first base course, placing it in the two 12-ft. lanes at the same time, with one machine operating just behind the other. When work was shifted to the second base course, the asphalt was placed in 11- and 13-ft. lanes to avoid possible formation of a line of weakness at the center joint.

The hot-mix was trucked to the pavers, being delivered at a temperature of 250-275 deg. F. and spread

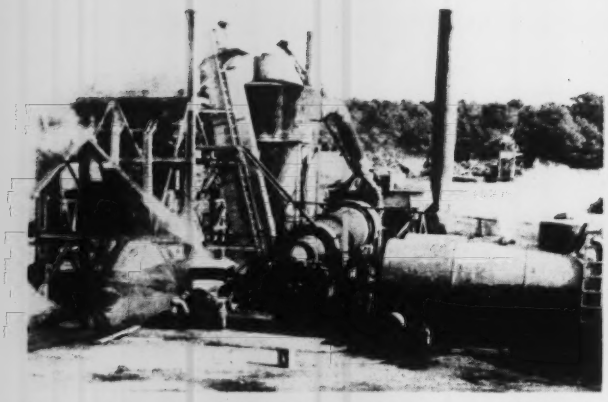


Fig. 6. Upward of 1,000 tons per day of material for the 2-in. top course was mixed through this 4,000-lb. batch-type plant on the south section of the turnpike.

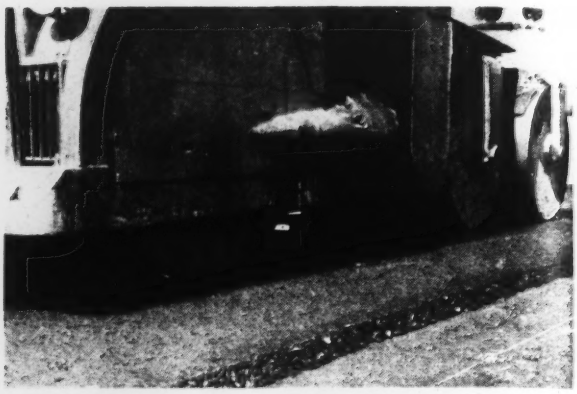


Fig. 7. Three-axle rollers, which could be loaded to a weight of 18 tons, were used by both contractors to compact each of the base courses and the top course.

in 3 or 3½ in. thickness for compaction to the 2½ or 3 in. thickness required. No forms were used for the edges but the coarse mix left a sharp edge.

The top course of the paving could have been placed with a single paver, so far as quantity was concerned, but the longitudinal joint between lanes was not satisfactory when the asphalt was allowed to cool between times of paving, so a second paver was added on the top course. Each of the pavers on top-course placed a 12-ft. wide lane about 2½ in. thick, which was compacted to 2 in.

Following the pavers on both base and top course, Perini had two 15 to 18-ton three-axle tandem rollers, on which oil pads were used to prevent the mix from sticking to the wheel. The three-axle rollers were operated until the required compaction and a smooth-riding surface had been obtained.

Somewhat less than half of the paving on the turnpike was done by Gibbons & Reed of Salt Lake City, Utah, using methods and equipment similar to those described for Perini. The north section of the work was split by the Saco River. Here, one mixing plant was set up on each side of the river and each plant was used alternately for base and top course.

For the base course, aggregate from nearby pits was fed to a bucket elevator that carried it to the rotating dryer. A hot elevator took the dried material to the top of three-compartment batch plants. One of these had a 4,000-lb. batch capacity and the other a 3,000-lb. capacity.

Long haul for aggregate

Stone coarse aggregate for the top course was trucked 20 miles from the Perini quarry or was shipped by rail from commercial sources and trucked into the plants. Placing operations were much as described for Perini's work except that the two pairs of pavers were used alternately on base and top course.

No hauling was permitted on either of the base courses. Consequently both contractors made every effort to keep the top course close up to the base course construction to eliminate hauling on shoulders or center strip, to which they were restricted until the paving was complete.

The 4-ft. inside and 8-ft. outside shoulder strips are crushed gravel for a depth of 6 in. This gravel is held by a sprayed-on asphaltic surface treatment into which stone chips are rolled. Use of light colored stone chips makes a contrast with the asphalt that clearly defines the roadway both day and night.

The median strip between the two roadways is shaped to about 12 in. higher than the paving and covered with 6 in. of loam, which is seeded. Shrubs or other planting in this area are not contemplated for the present.

Guard rails of the flexible steel type on wood posts are used just outside the surfaced shoulder in high-fill sections where conditions warrant.

The 18 ft. between surfaced lanes is maintained at all bridges, with separate structures for each roadway.

MAINE TURNPIKE—PRINCIPAL CONSTRUCTION CONTRACTS AND CONTRACTORS

Job	Location	Contractor	Home Office	Approximate Cost	In charge
Borings	all	Edward F. Hughes Co.	Boston, Mass.	$18,000	Herve Cole
Earthwork and drainage structures	south half	Savin Construction Corp.	East Hartford, Conn.	$3,250,000	L. F. McCarthy
Earthwork and drainage structures	north half	Lane Construction Corp.	Meriden, Conn.	$2,550,000	E. D. Moore
Bridges	York & Saco rivers	Ellis C. Snodgrass Inc. (Steel sublet to American Bridge Co.	Portland, Me.	$1,100,000	E. C. Snodgrass, Everett Ostwalt
Structures	41 small bridges, grade separations	Lane Construction Corp. (Steel sublet to American Bridge Co.	Meriden, Conn.	$3,600,000	G. B. Helmes, Everett Ostwalt
Paving	all	B. Perini & Sons, Inc. (North section sublet to Gibbons & Reed, Salt Lake City	Framingham, Mass.	$5,700,000	Louis Capone, Glen Nielson
Toll houses	at ends and four points	B. Perini & Sons, Inc.	Framingham, Mass.	$235,000	I. P. Rocheford

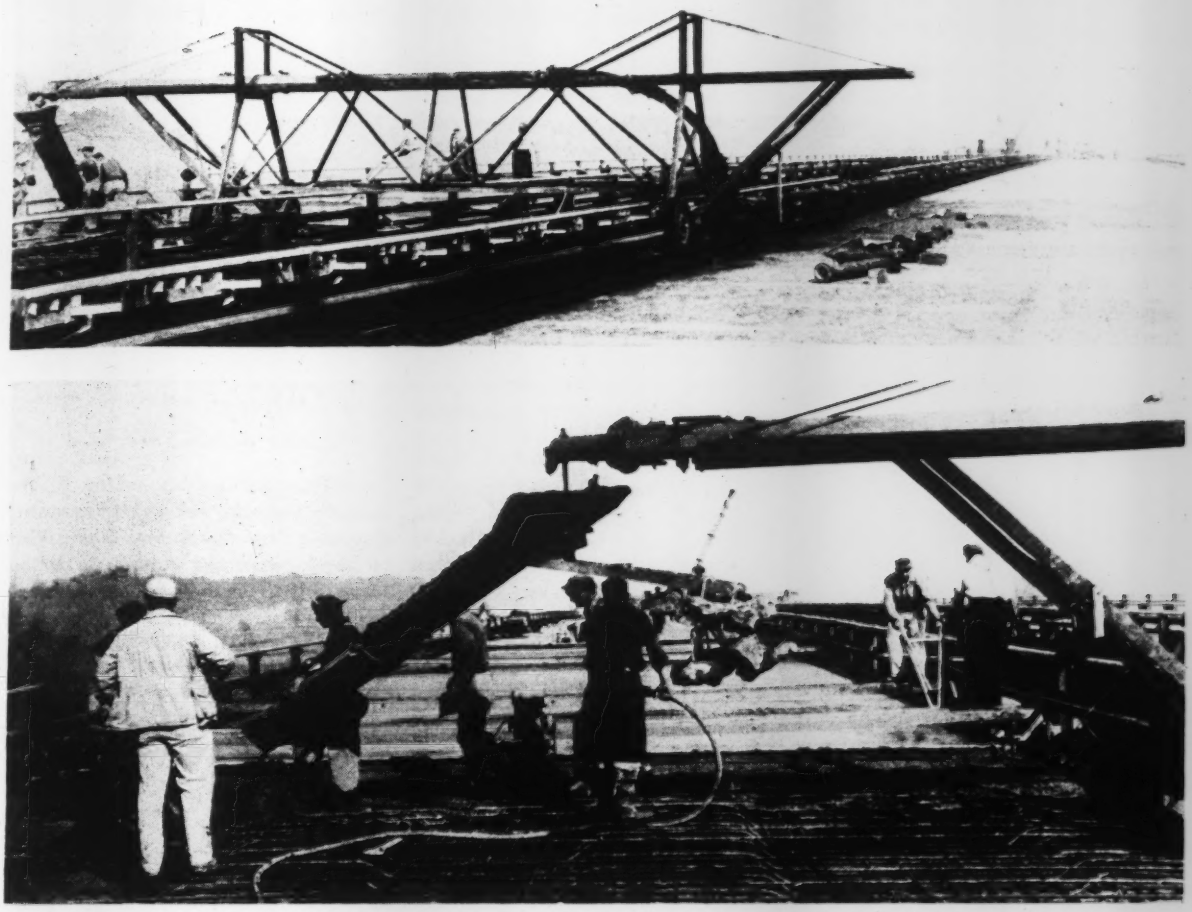


Fig. 8. Paving on the Saco River bridge was done by pumping the concrete to a traveller rolling on the inside curb of each of the two roadways (top). Concrete was distributed by a counterweighted chute and finished with a vibratory screed.

The one exception to this is the Saco River crossing where 95-ft. long skew piers carry separate deck-girder structures. Across the short bridges the full widths of roadway, including the paved shoulders, are maintained. At the long York Mousam. and Saco river bridges the deck widths are reduced to 28 ft.

The York River Bridge is on 85-ft. long 89-lb. per ft. 14x14-in. steel H-piles driven to rock. At the tide range the piles are protected by concrete encasements placed inside 30-in. dia. steel pipe shells. The pipe encasements extend 2 ft. below the mud line and were placed after the piles were driven. Gaskets at the pipe bottoms fitted around the piles and held tremie seals. After the concrete seal had set the pipes were pumped out and concreted to the full heights. It is expected that salt water and tidal scour will destroy the pipe casing in time but that the concrete will permanently protect the bearing piles.

Smaller bridges carrying the turnpike are rolled-beam spans with connections riveted in both shop and field construction. Bridges over the turnpike also are beam spans but are all welded to secure best appearance from smooth lines of the steel.

To facilitate entry and egress, four intermediate toll stations at Wells, Kennebunk, Biddeford and Saco are provided in addition to those at Kittery and Portland terminals.

Tolls for use of the highway have been fixed at fifty cents for passenger car use of the full 47-mile length of the highway with charges for trucks ranging up to $1.50 for heavy semi-trailers.

Financing, design, construction and operation is under supervision of the Maine Turnpike Authority of which Joseph T. Sayward is chairman and W. B. Getchell, Jr. is executive director. The authority has worked closely with the Maine State Highway Commission through the dual office of Lucius D. Barrow as chief engineer of the highway commission and secretary-treasurer of the Turnpike Authority. The use survey, on which feasibility of private financing of the turnpike was based, was made by Coverdale and Colpitts. Tripp & Co. Inc. of New York handled financing.

Design and supervision of construction has been handled for the authority by Howard, Needles, Tammen & Bergendoff. L. D. Brown has served as project engineer with N. C. Watkins resident engineer on the south half and H. J. Kibbler on the north. Hamilton Gray was consultant on soils. Stewart Associates, Inc. have supervised mixing and placing of the asphalt paving with Fred Crabtree in charge in the field.

Georgia Bridge Girder Pulled Into Place

Contents in Brief—*Construction of a new Chattahoochee River bridge was expedited by assembling on land the continuous girders for the four-span main channel section and pulling them into place with a hand winch. An all-welded launching nose 40 ft. long was used on the front of each assembly, which had a total length of 360 ft., and large-diameter rollers were installed temporarily on top of the piers. A five man crew was adequate to erect the girders by this method, a girder being advanced as much as 200 ft. in a single day.*

In constructing a multiple-span highway bridge across the Chattahoochee River in Georgia the general contractor saved considerable time and money by pulling the steel girder for the deck into place with a hand winch. If this plan had not been followed, it would have been necessary to bring floating equipment to the job or to have constructed considerable falsework. Cost to the contractor for the steel erection by the method used was only $4,500, which compares with another bid of $13,500 to do the work by other methods.

The bridge is part of a project calling for improvement of State Route 16 between the cities of Newnan and Carrollton. Designed for an H-15 loading, the crossing has a total length of 810 ft. Over the main channel a 4-span continuous unit consisting of two 80-ft. spans and two 100-ft. spans is used, while the remainder of the structure consists of simple spans varying from 35 to 50 ft. in length. Six lines of wide-flange rolled girder sections varying in size from 24-in. 84-lb. for the short spans to 36-in. 160-lb. for the longer spans support a 7-in. concrete deck. A 26-ft. roadway and two 2-ft. safety curbs are provided.

Erection of the girders for the simple approach plans was readily accomplished with a crawler crane working on land. In contrast, the piers in the main channel are fairly high and they are located in deep water at a point where swift currents are encountered during high water. In view of these conditions, in erecting the superstructure the use of falsework in the main channel was to be avoided if possible, as was the need for a floating rig. Therefore, the contractor selected to assemble on land the first sections for a line of the girders, and then to pull the attached sections into place as a unit, the last sections being added as work advanced.

Before erection of the girders for the 4-span unit was begun, three falsework bents were built between the approach piers of the north end of the crossing. These bents, which were constructed of timber piles, were required to provide temporary support for the girder sections for the main channel when the sections were set on top of the north approach piers.

Long launching nose used

Before pulling a line of the girders into place, an all-welded tapered launching nose 40 ft. long was welded to the forward end of the first section (Fig. 1.). This nose consisted of four 4x4x$\frac{3}{8}$-in. angles with lattice bracing. The depth of the nose varied from

Fig. 1. At the forward end of the girder being pulled into place a lightweight all-welded launching nose was used, which reduced the deflection in the cantilevered portion of the beam.

16 in. at the forward end to 34 in. at the point where it was welded to the girders.

Power for pulling the girders across the stream was provided by a 5-ton hand winch set on the deck of the south approach spans (Fig. 2). The winch was operated by one or two men, depending on the number of sections being moved, and the pulling force was applied to the launching nose through a four-part block and tackle.

To reduce the force required to move a string of girders, hollow steel rollers 6½ in. in diameter, 18 in. long and mounted in roller bearings were installed temporarily on the top of the piers. These rollers were of the type used so widely during the war in the construction of Bailey bridges. At the first pier at the north end a single roller was used, while two similar rollers were used at all other piers. The pulling force was further reduced by having a crawler crane raise the landward end of the beam assembly as it was moved along.

After the first section, which was 100 ft. long, had been pulled about 40 ft. toward the main channel, a 100-ft. section was attached and pulling continued for the length of this section. This process was then repeated until all of the 360 ft. of girder was in place, the last section being only 60 ft. long.

Since the girders were delivered to the job with the splice plates used at the joints already riveted, a method had to be found to keep the heads of the rivets in the lower plate from coming in contact with the temporary rollers. The solution was to insert three narrow 1¼-in. oak boards between the rollers and the girder as the joint moved over a given roller. One board was inserted between the two rows of rivets, the others outside. Since the ends of the boards were slightly tapered, no difficulty was encountered in inserting them.

Fig. 2. Power to pull the girder onto the river piers was provided by a hand winch on the south approach, the pulling force being applied through a four-part block and tackle.

As a section of the girder being erected was set on top of the approach piers it was was attached to those already in place by adding bolts in about one-half of the rivet holes at the splice. By use of bolts, rather than rivets, some flexibility was provided at each splice. At the same time there was sufficient stiffness in the string of girders to permit the forward end to be cantilevered from one pier to the next.

Once a girder for the full length of the four spans was in place the launching nose was cut free from the first section, and the rollers replaced with temporary timber blocking. In this work 35-ton hydraulic jacks set on the piers were used to support the beam. Soon afterward the permanent shoes were installed, and the bolts in the splices in the beam replaced with rivets.

Small excavation crew used

A crew of only five men was required to pull the girders into place. This group consisted of three laborers, the operator of the crawler crane, and the foremen.

On some days a line of girders was advanced as much as 200 ft., including the time required to connect the sections. However, on windy days it was impossible to work, as it was during wet weather. As a result of these restrictions, the actual pulling operation was attempted only about two days of some weeks. Nevertheless, the erection method, which was new to highway bridge work in Georgia, proved satisfactory.

The bridge was built by the Georgia State Highway Department for which C. N. Crocker is bridge engineer; E. W. Ellis, division engineer of Macon; W. C. Smith, Jr., resident engineer at Newnan, and W. P. Campbell, project engineer on the job.

For the Public Roads Administration, which aided in financing the work, B. P. McWhorter, is division engineer; J. T. Marshall, state engineer; Lyman C. Bradley, bridge engineer at Atlanta, and J. S. Call, head of construction in Georgia.

W. J. Tidwell, Jr., Inc., Douglasville, Ga., was the general contractor. For this firm Homer Jones was superintendent. The amount of Tidwell's contract was $194,056.00, which included construction of the piers and abutments.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Earthquakes in New York

Sir: I observe in your illustration of the model of the United Nations group of buildings—*ENR* Oct. 9, 1947, vol. p. 497—that only individual, unbraced columns appear in the ground story of the principal buildings.

It is to be hoped then that these columns and their end connections will be designed for full horizontal earthquakes loading applied in any direction. Earthquakes every now and then occur where so far as the memory of man extends they have never been before. On such occasions fatuous assumptions and constructions are shown to be precisely such.

HOMER M. HADLEY
Consulting Engineer
Seattle, Wash.

Growth of the NSPE

Sir: In your issue of Oct. 2, vol. p. 447, you have an editorial headed "Face The Facts". You make a comparison of the membership of the NSPE and the ASCE. This is not on a comparable basis since the ASCE has 6,500 junior members and the NSPE is limited to registered professional engineers, which is equal to associate and full membership of the ASCE. It is thus seen that the NSPE has 16,000 as compared to 14,500 in the ASCE. This is certainly a remarkable growth when you consider that the NSPE is only 13 years old as compared to the ASCE which is 95 years old.

Again, I understand that the ASCE did not increase its membership this year, whereas the NSPE has increased its membership almost 5,000. I think too that the *raison d'etre* for your article is that there is a strong sentiment favoring the separation of professional and technical activities. The result of the ballot in the ASCE clearly indicates this. As I have indicated before, I feel that there should be a unification of all the societies allowing to each of the Founder Societies its technical branch and to the NSPE professional activities since it represents all branches of engineering.

The Founder Societies deserve much credit for their professional activities in the past, but I think the future clearly indicates that this work should be done by one society for all branches of engineering.

SAMUEL I. SACKS,
Philadelphia, Pa.

Publicize Pollution Hazards

Sir: I am shocked by the position taken by Mr. N. T. Veatch as president of the American Water Works Association in regard to the type of information contained in the September issue of the *Woman's Home Companion*, under the title of "Foul —But You Drink It!" (*ENR* Sept. 11, 1947, vol. p. 361).

As an engineer, living and practicing in an area that is just beginning to pass the point of adolescence and grow into young maturity, I have watched the increasing pollution and contamination of both ground and surface waters with great apprehension. As I read this article in the *Companion* I found definite parallels in the immediate area of our practice. I have observed the effect of uninformed complacency in dealing with crystal clear, cool waters direct from the well and the "finest drinking waters in the country"; and I have seen this complacency blasted by a laboratory report showing this water to be well seasoned with colon bacillus.

It seems to me that any technical organization is making a grave error in merely "bitterly denouncing" an article of this type. Instead of adopting a policy of censure and rebuke toward the publication of such matter, disapprobation should be replaced with a sincere and open discussion of what can be done with water supply by proper legislation controlling the present highly destructive methods of waste disposal. The time for the technical man to isolate himself in his ivory tower of knowledge and object to the man on the street being told wherein the things he takes for granted are deficient is no longer with us. No problem has ever been solved by a policy of sequestration.

It is a public failing to hide faults and to gloss over inadequate facilities; it is the great responsibility of technical men and technical organizations to see that this glossing over is not permitted and that public confidence is founded upon full knowledge of conditions and of the means of correcting these conditions. It is my sincere thought that Mr. Veatch, of the American Water Works Association, has taken a short-sighted and ill-advised attitude and that there should be a revision wherein support is given to any move that will further control of the pollution of the essential basic resource upon which our whole economy must rest—adequate, potable and safe waters.

CHARLES P. REMING
Executive Vice President
J. W. Beretta Engineers, Inc.
San Antonio, Texas

The Rhine and U. S. Waterways

Sir: We cannot recall reading so splendid an article on waterways as "The Rhine," (*ENR* Oct. 16, 1947 vol p. 514).

That part of the first paragraph, under "The Articles and the Authors," on page 515, which states in part, that "Built into a dominant position in Europe's economy by the works of engineers and construction men, the Rhine must be restored to something near its former efficiency by these same forces if that continent's recovery, and even world recovery, is to be achieved," is thought provoking. If Rhine navigation has been vital to a so large part of Europe for so many decades, why have we interests in this country who stop at nothing to hinder the development of our great Mississippi-Ohio River system?

The opportunities for usefulness in this great American inland waterway system exceed tremendously the possibilities for usefulness of the Rhine system.

The transport possibilities of the Mississippi-Ohio system are practi-

cally limitless. Continuing development of this great waterway system will benefit the people and the nation incalculably.

Those with a knowledge of transportation know that certain materials and commodities can be transported by water at costs which no other system can approach. They know, too, that each system creates tonnage for the others; that they help rather than injure each other. Each form of transportation supplements the others; each has its proper place. Certain tonnage is naturally the business of railroads. Other tonnage is naturally the business of trucks. It is indisputable that certain freight is naturally the business of waterways an can be transported over them at costs which no other system can approach.

Those who condemn waterway development talk as though our great natural inland and intracoastal waterways, unparalleled in all the world, should have been left just as they were when Columbus reached our shores. Of course, such condemnation stems from special interest selfishness with no regard for the general welfare.

Sensible cooperation will not only be helpful to each method; it will increase benefits to the people and add strength to our economic system.

We hope your article will be widely read. It will open the eyes of many Americans.

WENDELL PHILLIPS DODGE,
Editor, The Marine News
New York, N. Y.

More on Sardis Drainage

Sir: In the article "Vertical Relief Wells Reduce Uplift on Sardis and Fort Peck Dams," ENR, Aug. 21, 1947, vol. p. 246, the following discrepancies were noted:

The caption of Fig. 2 states that the trench was lined with porous concrete to prevent erosion. While prevention of erosion was a major consideration, porous concrete was used to take care of possible seepage.

In Fig. 2, in the detail at the downstream toe, the extended pipe should be shown cut flush with the ditch slope. In the detail of the ditch in the same figure, the dimension 4 ft. should read 18 in., but the drawing is shown to about the correct scale.

It is stated that vertical drains extend to about elevation 185. As noted, the wells average about 40 ft. in depth below the bottom of the trench, but this makes their bottom elevation 170.

The article states that for permanency the drains are creosoted wood stave pipe. Recently, the American Creosoting Association wrote the district engineer, Vicksburg, and asked if the wood pipe was creosoted for added protection and requested clarification of the statement. The district engineer replied that the pipe was obtained from government surplus and creosoted pipe was used because it was the only redwood pipe available.

R. W. CRAWFORD,
Maj. Gen., U. S. Army,
President, Mississippi River Commission
Vicksburg, Miss.

More About Portable Hangar

Sir: The recent account of the tests and the appended brief description of the hangar in *ENR* Oct. 16, vol. p. 539, bring to mind some of the unusual aspects of this engineering problem. As stated in the article, the Army set quite rigid specifications for this hangar, but every effort was made in the design to exceed the specifications wherever possible with respect to shipping weight and ease of erection.

The standards to which the hangar was designed presupposed an inexperienced G. I. erection crew, with a minimum of training, assigned to erect the hangar quickly at a location overseas where power and customary erection equipment were lacking. To this end, individual structural members were made light enough to be handled by manpower and as interchangeable as possible — double punching if necessary; and erection equipment was hand powered and composed of parts of the structure that were installed in the latter part of the erection schedule.

For example, the A-frame erection tower used to raise the arches was mainly constructed of the upper-door guide tees, door-canopy stiffening plates, end-framing diagonal struts and arch sway rods. In moving the tower, which rode on wheels that were later used for the main hangar doors, door rails were utilized for smooth transfer from one bay to another. Hand winches, which raised the A-frames in place and later lifted the arches, were part of the regular hangar equipment and finally saw permanent service as the power unit for raising and lowering the vertical-lift tail gates in normal operation. Ladders used on the A-frame tower and jacking frames were later adopted for service as scaffolding supports in sheeting the end walls. After this function was carried out, the ladders and jacking frames were then assigned to duty as utility ladders around the hangar.

In fact, before some of the members were finally placed in the structure, they had served several functions in the erection procedure. By thus squeezing the maximum utility out of every piece, the designers intended that each pound of material shipped overseas should more than justify the valuable shipping space it occupied.

The B-29 hangar was developed too late in the war to become as well known as some of the wartime structures. It is noteworthy because it represents a direct and ingenious solution to a wartime engineering problem. Mr. Strobel was the creative force behind the project and his insistence on a simpler, lighter and better way of doing it for each item made the finished product the job that it was.

MILTON A. KARP,
Engineer, Ellis Wing Taylor,
Los Angeles, Calif.

Tribute from Abroad

Sir: Robert Brooks, consulting engineer of St. Louis, was a representative of the American Public Works Association at the recent International Conference of Public Cleansing held at Amsterdam, Holland. He endeared himself to us all and gave lustre and dignity to his association.

In an address at the conference, Mr. Brooks emphasized that we as professional engineers must give ourselves in service not only to our own countries but also to other countries. He properly pointed out that international meetings can contribute much to bridging the gaps caused by the violence of war.

G. HOLDEN
Chief Sanitary Inspector & Cleansing Superintendent
Whitley Bay Urban District Council
Whitley Bay, England

From Field and Office

WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS

Chart for Timber Stop-Logs Aids Selection of Sizes

Determination of sizes of stop-log timbers is made easy by means of the chart in Fig. 1. Based on allowable stresses of 1,000 psi. in bending, 100 psi. in shear and 150 psi. in bearing, the chart gives nominal and actual thicknesses and minimum length of end bearing for various heads of fresh water, assuming simple spans. Below a head of about 31 ft., bending governs; above, shear.

In the case of an 8-ft. wide flume to be closed off by stop-logs against a maximum depth of 10 ft. of water, the intersection of the ordinates representing a span of 8 ft. and a head of 10 ft. indicates a nominal thickness of 6 in. The chart also shows that this thickness must be used for all heads between 4½ and 10 ft. Thus, 6-in. timbers must be used for the bottom 5½ ft. For the next 2 ft., 4-in. timbers may be used, for the top 2½ ft., 3-in. Dotted lines indicate length of end bearing required.

When other unit stresses are specified, the head should be changed in inverse proportion to the stresses. For example, for 2,000 psi. in bending, the chart should be entered with one-half the actual head. An alternative is to calculate the thickness, which must not be less than $6.85\ L\sqrt{h/f}$ or $3.90\ Lh/s$, where L is the span in feet, h the depth of water to the middle of the stop-log in feet, f the allowable bending stress in psi., s the allowable shear in psi. and the thickness required is in inches.

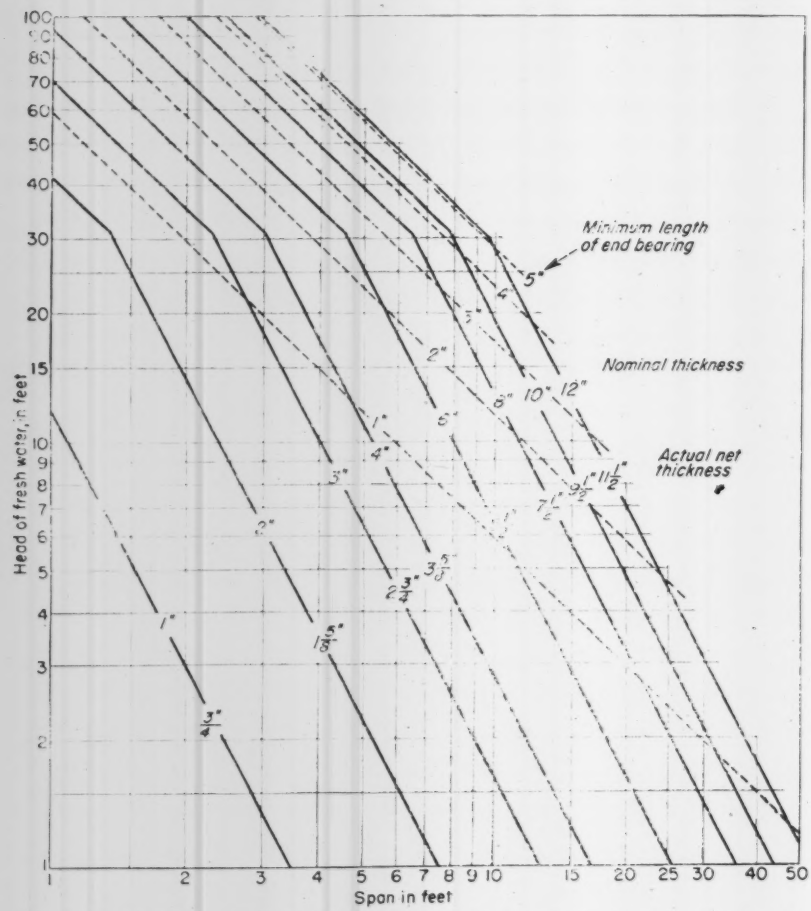


Fig. 1. Chart gives horizontal thickness and length of end bearing for stop-log timbers on simple-beam spans.

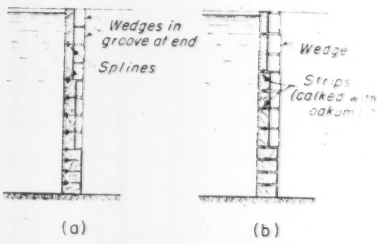
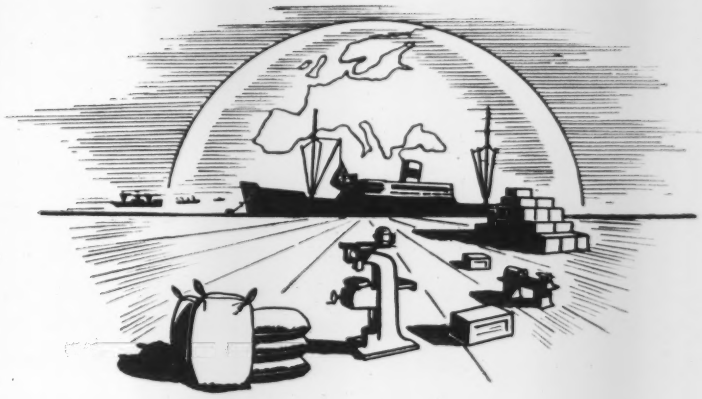


Fig. 2. Two methods of controlling leakage through stop-log bulkheads.

If splines are considered necessary, they may be placed as shown in Fig. 2(a). When the thickness of the timbers is varied, the flexibility of the upper logs will not endanger the splines. Actually, shear across the splines is greater when all the logs are of the same thickness. Good results have been obtained by using ½-in. thick strips nailed to the logs as shown at (b). After the logs have been wedged in tightly, the cracks can be calked with oakum. This method is much cheaper than the one using splines and has the advantage of easier removal.

When the area protected by stop-logs is to be unwatered for a considerable time, it may be economical to make the barrier of reinforced concrete rather than timber. Care must be taken to avoid differential head during the curing period. If only horizontal bars are used, removal of the concrete wall is not too difficult. The concrete wall is more likely to be water tight than a wooden wall. Under some conditions, the use of precast concrete stop-logs may be economical.

The use of steel stop-logs or steel-armored wooden logs is essential when stop-logs must be used under high heads or for severe handling conditions.—C. J. Posey, *Professor of Hydraulics and Structural Engineering, State University of Iowa, Iowa City.*



The Marshall Program

WHAT WILL THE MARSHALL PROGRAM mean to American business? What industries will be called upon to meet the needs, and how great are they likely to be? Will the program carry with it another dose of inflation? Are new bottlenecks being created, or will old ones gain a new lease on life? Where are material shortages likely to fall most heavily?

These and a hundred other questions are in the minds of many American businessmen today. Unfortunately, no final or precise answer can be given to some of them. And it is in the nature of the problem which the Marshall program tackles — that of getting Western Europe on a steady economic foundation — that no precise answers are going to be possible. We have only to view the bad breaks Europe has collected since V-J Day, including the blizzards and drought of this past year, to see how the economic picture can change on short notice.

Nonetheless, the broad dimensions of a Marshall program are sufficiently clear to permit more than a guess about its impact on American business. Both here and abroad committees have been busy for months shaping up Western Europe's rehabilitation needs. At the same time a mine of information has been pulled together about our own output and capacity. The result is a small library of technical reports which carry most of the facts Congress needs for a decision on the immediate problem.

McGraw-Hill's Department of Economics has waded through these reports and queried industry itself to determine the likely effect of the Marshall program on American business. This report carries the main results of their investigation.

One conclusion emerges clear-cut. American business can not provide the assistance Western Europe will need without considerable cost to itself. Such costs are outweighed by the gains that can be expected, economic and social, as well as political. Nevertheless, business will want to anticipate those difficulties that might arise and move to overcome them. The following pages, therefore, highlight both the problems and the benefits that are likely to fall to American business as a result of the Marshall program.

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The Marshall Program

WHAT IT MEANS TO AMERICAN BUSINESS

WESTERN EUROPE'S INDUSTRIAL MACHINE has picked up considerable speed since V-J Day. But vital gears are not meshing and industry isn't getting the job done that is necessary. The things people most need are those that are lacking. Food output is down more than a fourth. Coal production is lower by a fifth. The net result is a living standard that ranges from bare subsistence in some countries to a level far short of prewar in others. And even this depends on imports for which the area can't pay.

This melancholy economic picture has its political counterpart. The best organized and the most energetic political party in France and Italy is Communist. While the Communists in Germany and Austria are less strong, they still are an element to be reckoned with. These are all key areas which, should they fall within the orbit of an unfriendly power, could well destroy the freedom of political action throughout all of Western Europe.

Needless to say, such a development would have military implications of the utmost importance. It is a military axiom that any defense must be organized in depth. And in the event of any emergency "depth" for the United States must now include Western Europe.

It is this complex mixture of the economic, political, and military, then, that has led to the Marshall program. Underlying this program is a deep conviction: That Western Europe possesses the skills and resources necessary to work out its own economic salvation. The fact that in two years it has not done so reflects both the depth of the wounds it suffered in war and the bad breaks it has received since then. With time these skills and resources can reassert themselves. Meanwhile, food, equipment, and materials from America will shorten the job and enable Western Europe to stay on its feet.

Western Europe's Program

SECRETARY MARSHALL gave the program that bears his name its initial push. But it is Western Europe which quickly seized the initiative. A committee of 16 nations met and surveyed their needs and resources. From this survey grew a broad program designed to achieve a balance between the economies of Western Europe and the rest of the world by 1952. Moreover, the program seeks such a balance while raising the standard of living close to that of pre-war days. Hunger and disorder which force extreme social change might thus be eliminated.

As developed thus far Western Europe's economic program is not a detailed plan of action. It does, however, lay out the terrain that must be covered if its objectives are to be reached. Four fields are staked out for action. One involves an immense effort on the part of the cooperating nations to raise their own capacity and output. A second requires the establishment of internal financial stability in countries like France and Italy that now lack it. A third looks forward to closer economic cooperation between the participating countries on a more permanent basis. Finally, a fourth lays out the extent and nature of the aid which Western Europe will require from the United States and the rest of the Western Hemisphere.

It is this fourth aspect of Western Europe's program that is of primary concern to us here. Nevertheless, the hard core of the Marshall Plan is that aid alone can not solve Europe's problem. And it is no exaggeration to say that the most important features of any program are those which Europe itself must fulfill. In this regard, nothing is more critical than the goals set for an expanded capacity and production.

THE PRODUCTION GOALS

Europe's production goals also have an importance for American business. They suggest lines in which Europe eventually will become independent of the United States, as well as competitive in world markets. Here are some of their highlights:

a) An increase of steel ingot production to 61 million tons, a fifth higher than 1938.
b) Development of oil refining capacity to 2½ times pre-war (largely for refining imported crude).
c) Increase of coal output to 644 million tons (U.S. output in 1947 is around 600 million tons).
d) Rapid advance in the output of electrical products—needed in part to help equip a 25 million kw expansion of generating capacity.
e) A large increase in capacity of other key equipment industries; e.g., mine equipment, petroleum equipment, farm machinery, construction equipment.
f) Restoration of pre-war output of bread grains and cereals; expansion in sugar, potatoes, fats and oils.
g) Restoration of merchant fleets to pre-war size.

These are very ambitious goals. They call for a great advance from the current position, as the chart on the next text page shows. In some aspects (electricity, foodstuffs, perhaps coal, are examples) they appear unlikely to be met, at least by 1952. Such a development would, of course, modify the import list.

THE IMPORT REQUIREMENTS

To do the job that confronts it Western Europe has said it needs more than $20.5 billion of goods and services from this country over a period of four years. In return it would plan to offer us goods and services to the value of $4.7 billion. That leaves a whopping deficit of about $16 billion. The heaviest commodity export ($6 billion) – and the biggest chunk of the deficit – would arise next year. Thereafter, exports would fall off about

(Continued on page after next)

Coal: KEY TO RECOVERY

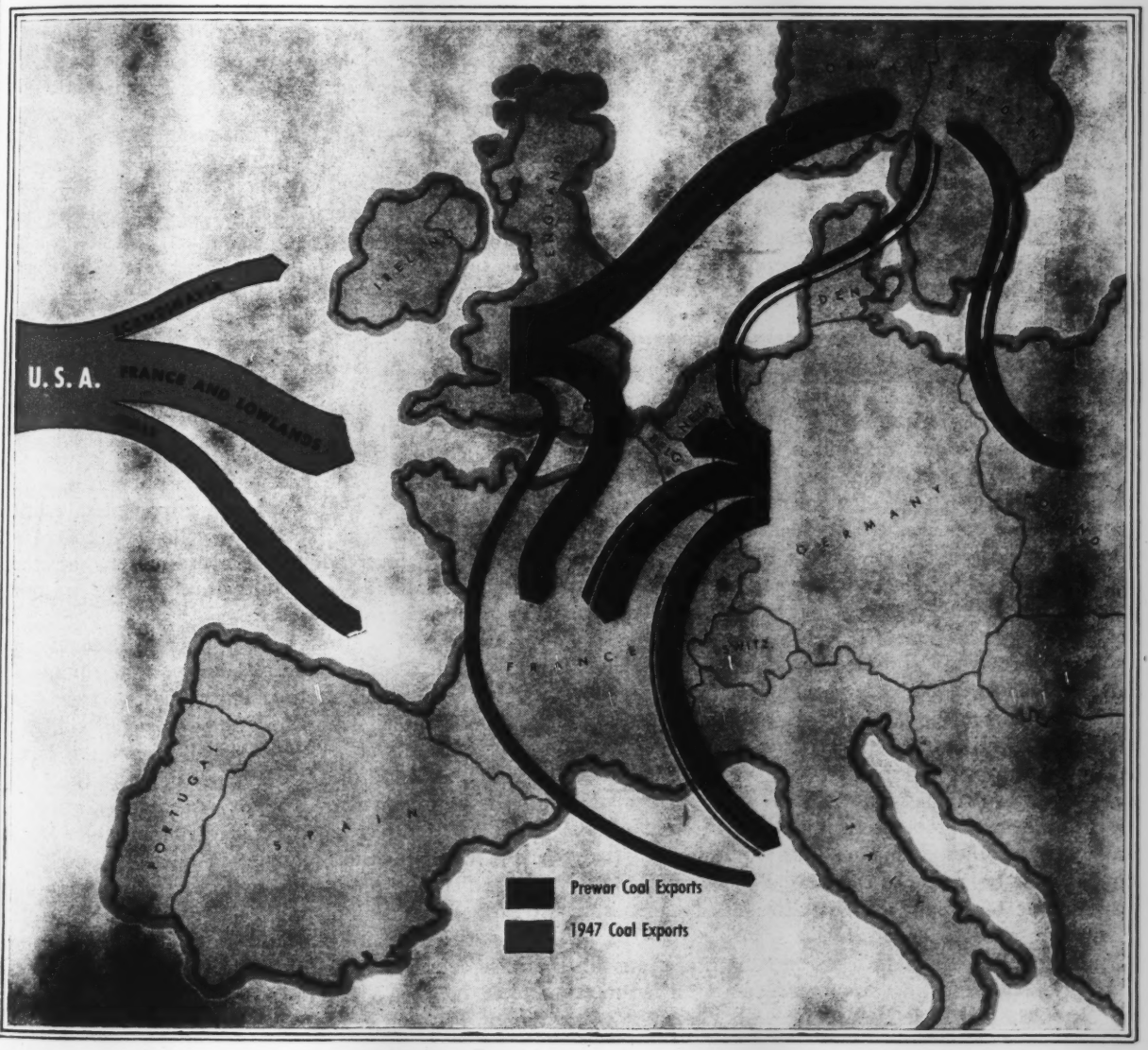
COAL IS AT THE HEART of what is wrong with European industry today. Because of the lack of coal, factories run part time, fields are less fertile, and firesides are cold.

What Western Europe plans to do about coal is typical of what it plans to do about industry generally. The job is to expand output in its own producing centers, resume exports within the region, and cut down costly and unnecessary imports from the United States.

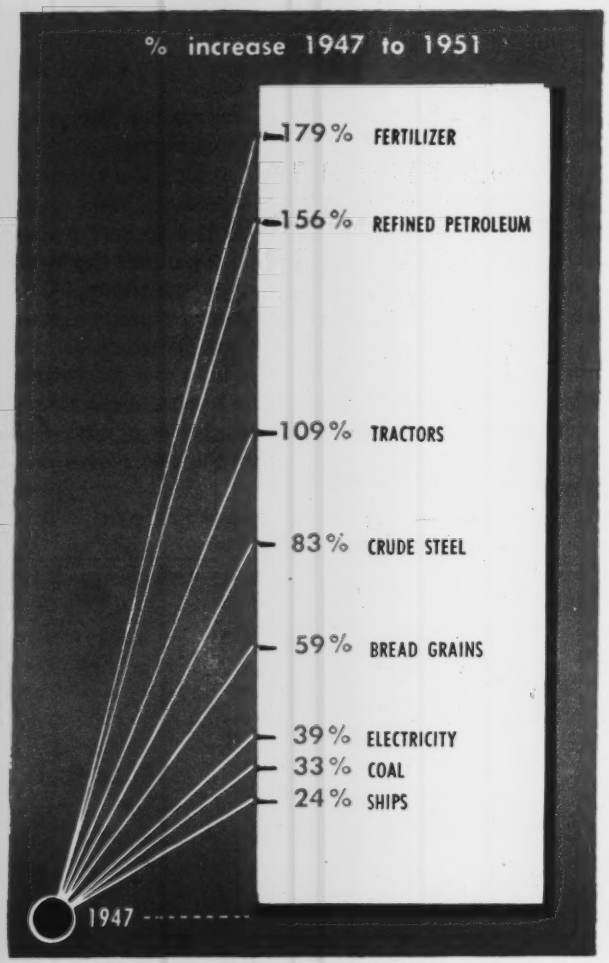
In the case of coal this means restoring a flow which in pre-war days was the life-blood of Europe's industry. As the map shows, two great coal centers – Britain and Germany – supplied not only their own nationals but the needs of other countries as well. Today Britain can't meet its own requirements and coal production in the Ruhr is but half of what it was. The result is the costly necessity to haul coal from the United States.

Western Europe will need 45.2 million short tons of U.S. coal next year. Meanwhile, it plans to build up its own production. By 1951 it hopes to turn out coal at more than the pre-war rate, with Britain and the Ruhr sending sizeable shipments to their neighbors. Coal from the U.S. will have been cut to 6.6 million tons.

Two developments are vital. First, Western Europe must reequip its mines. This calls for a vast production effort on its own part, as well as the import of specialized equipment from the U.S. Second, a river of coal, 34.2 million tons in 1951, must breach the iron curtain and flow from Poland to the West.



Western Europe's Production Goals



one-third to a total of $4.1 billion in 1951.

Nor is the U. S. the only base from which Europe needs vital supplies for which it can't pay. Canada and Latin America are asked to shoulder a trade deficit that comes to almost $6 billions for the four years. Needless to say, if food and raw materials are not available on credit from these areas, the larger will be the sum required from the U. S.

There already is considerable debate about these figures. There will be a lot more while Congress considers the aid program. The fact is, and this is the conclusion at which the President's Committee on Foreign Aid arrived, no final estimate of how much Western Europe's needs might cost over four years can be made. Crops, industrial production, prices, trade relationships and a host of other factors may turn out differently than anyone now expects. For this reason the United States may choose to review Western Europe's progress and its import needs on a yearly basis, rather than fix in detail a four year program. For the same reason our discussion of Western Europe's requirements concentrates largely on the picture in 1948.

As it now stands, the list of items that Europe wants to get from us is more general than specific. Moreover, inter-departmental committees have taken the list and pared it down, chiefly on grounds the supplies are not available. Here is the way the general categories shape up, both as initially requested and as revised. The figures represent total imports and are in millions of dollars.

	European Committee Estimate for 1948	Estimate for 1948 as revised	European Committee Estimate 1948-52
Food, Feed, and Fertilizer	1,500	1,270	5,400
Cotton	400	350	2,000
Coal	340	370	700
Iron and Steel Products	370	230	1,200
Petroleum Products	510	485	2,200
Chemicals	250	200	850
Timber	100	95	400
Farm Machinery	370	100	1,300
Inland Transport Equipment	200	60	490
Petroleum Equipment	170	130	555
Mining Machinery	80	80	220
Electrical Equipment	150	125	500
Machine Tools and other Machinery	545	450	1,750
Miscellaneous	1,065	1,065	3,030
	6,050	5,010	20,395

A quick glance behind these totals reveals the following:

Among agricultural supplies breadgrains and feedstuffs are the big items. Dairy products and fats and oils are also sizeable.

Of the $2 billion or more of petroleum products, three-fourths are refined and one-fourth is crude.

Coal shipments will bulk large the first year (45 million tons) but they fall off rapidly thereafter.

The steel request originally included 1.5 million tons of scrap in 1948 and more thereafter. This isn't available. Of the finished items, sheet and tin plate come to 744,000 tons in 1948, the peak year.

The chemicals wanted are industrial chemicals, paints, and medicinals as well as a lot of unnamed specialties.

The huge catch-all labeled miscellaneous covers textiles and whatever additional consumer manufactures Europe will seek. Aircraft and surplus ships are other important items in the group.

A number of items on the equipment list could cause considerable trouble. Farm machinery, mine equipment, refining equipment, electrical apparatus, and freight cars are among these. Each is examined in detail below.

These exports under the Marshall program, if carried out, will affect all of U. S. business down to the corner grocery store. In many instances the impact will be so slight and indirect as to be hardly noticeable. But in a few industries the program will loom as a major element, dictating production patterns and setting a limit to capital expansion plans.

It's hard to paint a simple picture of a situation so diverse as this. We try to do so below by dividing the effects of the Marshall program into several broad groups. First we consider the impact of the program on

the general level of business. Next, we cover the impact on leading industries – steel, oil, electrical equipment, farm machinery, and the like – and the effect on business through the creation of shortages in these items. Finally, we examine the influence of the program on farm prices and living costs.

THE OVER-ALL LOOK

The Marshall program comes at a time when certain demands contributing great inflationary pressure on business are beginning to slacken. While it will help hold business at a high level, the program itself is not great enough to maintain a general inflationary pressure. Nevertheless, it will give new strength to shortages that have been troublesome to business. In these latter areas, as well as on the food front, prices will continue firm and may go even higher.

If the program is carried out along lines described above exports to Europe will run about $5 billion. The gain here will offset a decline that has already begun in U.S. exports to other areas. After a careful study of these divergent trends, we conclude the end result is likely to be a total export of goods at a rate of about $15 billion in 1948. However, this rate will only be reached after the program starts rolling. The sale of services – shipping, tourist and the like – will add another $2.5 billion to our foreign account. Moreover, this over-all sum of $17.5 billion probably will run about $9 or $10 billion greater than our imports.

Under the Marshall program, then, our foreign trade in 1948 will be carried toward the peak that prevailed in second-quarter 1947. But the over-all inflationary impact of exports in 1948 is bound to be less than it was in second quarter 1947. Not only is our capacity to produce growing, but certain elements in our domestic demand are almost certain to be less strong next year.

This last fact is important and needs to be spelled out. Indeed, it's impossible to determine the effects of the Marshall program without some idea of what would happen to business without it. The accompanying chart which shows how our gross product has been split up in the past several years serves as the starting point for such an estimate. There it can be seen that the spending of domestic consumers takes the biggest slice of the gross product ($164 billion). However, the share going to business and to government also has been sizeable (about $30 billion each). Alongside each of these the net expenditure of foreigners on our goods seems small. Nevertheless, it has a tremendous importance to a huge number of business firms and industries.

Left by themselves, the spending of consumers and of government would be likely to fall very little if at all next year. But business outlays – spending on plant, equipment, inventories, and residential housing – are another matter. Here the vulnerable items are plant and equipment. Capital expansion has been extraordinarily large for two years, and in not a few cases business is completing its initial post-war program of capacity expansion. Therefore, some decline, but not a large one, is expected in the aggregate of business spending during 1948. This in turn would have some reaction – but again a minor one – on the spending of consumers.

The net effect of such developments should be to place industry in a better position to meet the pressing needs of the Marshall program. This does not mean, however, that the program can be handled without difficulty. The trouble is that many of the items Western Europe most needs are those which would, under normal conditions, continue in tight supply. It is these bottlenecks that business will want to anticipate and, to the extent possible, overcome. Here are the facts concerning the most important of them.

COAL: TRANSPORT IS THE DIFFICULTY

Western Europe wants 45 million tons of coal from the U. S. in 1948. Thereafter requirements drop sharply to 6½ million tons in 1951.

U. S. production of bituminous next year ought to equal the 600 million tons turned out in 1947. If it does we can meet Europe's need. However, the job will call for careful scheduling of delivery. For the real problem in coal is a shortage of coal cars. This has plagued industrial consumers in 1947. Unless car turn-around times are improved (they now average 14 days as against 11 during the war) car shortages will continue through 1948. Under such circumstances, exports to Europe won't permit the accumulation of normal stockpiles – a fact managements in many industries won't like.

Any actual shortage in production that might develop will be limited to special types of coal – particularly the better grades of coking and by-product coal. Europe has concentrated largely on these. Such concentration isn't necessary, but since transport costs (the big element for Europe) are about the same for all grades, Europe has

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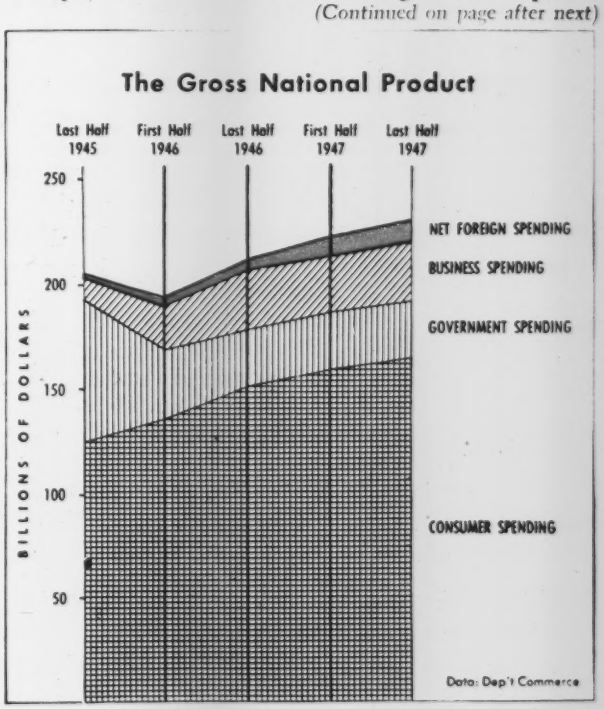
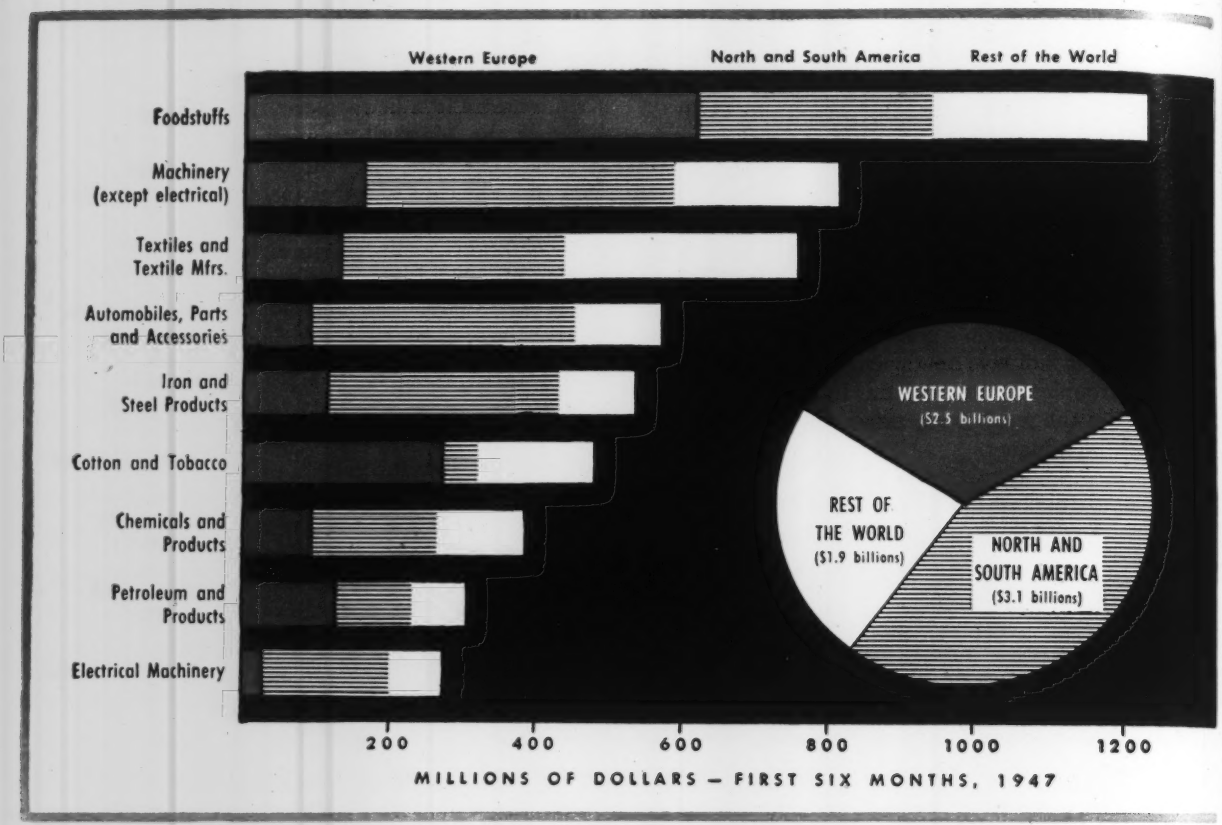




U. S. EXPORTS . . . Where they go — What they are

U. S. EXPORTS THIS YEAR hit an all time high. Shipments in the first six months were at an annual rate of $15 billion, four times the pre-war rate. Since then they have declined, but not greatly. The export rate now is about $13 billion.

Foodstuffs have moved to the top of the export list. The needs of Europe combined with crop failure in Southeast Asia have revived an export that before the war seemed all but dead. About half this record flow has been directed to countries included in the Marshall program.

Next on the list are the durable goods that have come to symbolize the strength of American industry. Machinery, automobiles, and steel products are all in extraordinary demand abroad. In spite of domestic shortages, shipments have been relatively heavy. Thus in one form or another about 18% of our tight steel supply has moved abroad this year. Canada and Latin America have been the big customers, and sizeable quantities of machinery have also gone to Russia. Other than France (which had a big loan for the purpose) Western Europe has not been in the market. They've needed the goods but lacked the dollars.

Textiles have been another huge export group. Here the influx of new foreign customers has been warmly welcomed. For heavy buying from abroad has kept textile output going at a good pace.

Cotton, tobacco, oil, and chemicals are other supplies that bulk large in U.S. trade. Western Europe has been a principal buyer of all except chemicals. Canada and Latin America again have been at the head of the line for these last items.

Regardless of the Marshall Program, some shift in U.S. export trade could be expected in 1948. The recent splurge of foreign buying cannot be maintained if for no other reason than that funds will not be available. U.S. import of goods and services – the chief source of dollars for most of the world – has been only 40% of exports. About $10 billion of loans and relief grants helped keep Europe in the market. At the same time, foreign nations drew down dollar balances and shipped gold.

Net effect of the Marshall program on exports is to provide $4 to $5 billion of trade that otherwise is lacking. Not all this added trade need be with Europe. If the U.S. provides dollars for Western Europe to buy in Latin America and Canada—which it well might—those areas will spend more here. Nevertheless, under the Marshall program much more of our trade will be directed toward Western Europe and the things it wants. These are foodstuffs, industrial supplies, and machinery. Little in the way of textiles or automotive equipment is on Western Europe's shopping list.

sought the best. U. S. utilities, steel and gas manufacturers, and the Great Lakes trade are large domestic users of these fuels. They will continue to feel competitive pressure unless Europe's buying habits are changed.

PETROLEUM — WORLD-WIDE SHORTAGE

Regardless of whether the U. S. provides the full amount of petroleum Western Europe has asked for, industry and households may have to go slower on switching to fuel oil than they desire. Oil already is in tight supply in America, and this reflects a shortage that is world wide. The cause of this shortage lies not only in refining and production bottlenecks. Perhaps even more important is the lack of sufficient transport capacity, particularly pipe-line and tank car. With steel (including pipe and tubes) as it is and will be, this tight oil situation can't take a quick turn for the better.

Europe wants to build up its imports of crude and do a steadily larger amount of processing on its home grounds. Here is the way dollar imports of the two broad groups were initially scheduled by the European Committee at Paris (figures are millions of tons).

	Imports of Crude	Imports of Refined Products
1947	6.1	17.0
1948	8.5	17.7
1949	10.2	19.0
1950	12.6	18.2
1951	18.8	13.7

These requirements are not likely to be met in full during 1948. However, we should at least match and perhaps slightly better the export of 1947. In 1949 the situation should be somewhat easier. But no one will be surprised if refinery construction in Europe lags and more refined products are needed than plans call for.

The European Committee was careful to say these imports were from "dollar areas." That means they are supplied by American companies (who need payment in dollars), but not necessarily from the United States. As a matter of fact, almost 60% of Europe's oil in 1946 came from the Caribbean and the Middle East, as against 20% from the U. S. proper. American companies furnish much of this foreign oil and any increase in exports probably will flow from foreign supplies.

All this is not to say that the export of oil from the U. S. proper is not considerable. It is, with exports this year running at a rate of more than $600 million. About $250 million of this—chiefly refined products—has gone to Europe. From the standpoint of refining capacity alone, shipments of refined products from the U. S. could, in a pinch, be stepped up slightly. But capacity also should be available in the Caribbean and the Middle East. It makes economic sense to ship from these other areas and they should get the business.

CHEMICALS AND FERTILIZER

Nitrogen fertilizer is the one U. S. chemical product high on Western Europe's priority list. Industrial chemicals and pharmaceuticals are wanted, but are not likely to be purchased in quantity if funds run low.

Nitrogen, of course, is in extremely short supply the world over. Moreover, this shortage probably will not be licked until the early Fifties. If Western Europe were to receive the full 319,700 tons of nitrogen it desires from the Western Hemisphere in 1948, consumption in the U. S. would of necessity be reduced. Not only would commercial exports have to be increased, U. S. imports would also decline. Large supplies (180,000 tons) from Canada and Latin America make the U. S. a net importer on commercial account.

The likelihood is that Western Europe will get more nitrogen next year than this. However, the advance will come out of a small expansion of production, leaving U. S. consumption what it was. From the U. S. some 70,000 tons (6½% of production) may be shipped. This would equal commercial exports to all areas in 1947.

The U. S. also will provide phosphates to Western Europe — perhaps 80 to 85,000 tons. However, production should be adequate to carry this with little trouble.

Among other chemical products, Western Europe would like the following (figures are millions of dollars).

	1948	1948-51
Industrial Chemicals	50	190
Paints and Pigments	40	145
Coal Tar products, Medicinals, etc.	160	515
	250	850

No forecast of our actual export of these products is possible. However, shipments are likely to run considerably lower than the above figures suggest. Western European production can fill the most essential needs. Since supplies here are very tight on many items, exports to Europe may not greatly exceed those of 1947.

STEEL — STILL THE NO. 1 PROBLEM

No material caused more trouble for U. S. industry in 1947 than steel. The extent of the shortage in 1948 — and the possibility that it might end — has been a key element in the plans of many producers for next year. Under such circumstances the needs of Western Europe are bound to be weighed and measured with care.

Here is what the initial report from Paris asked for in the way of steel (figures in thousands of tons).

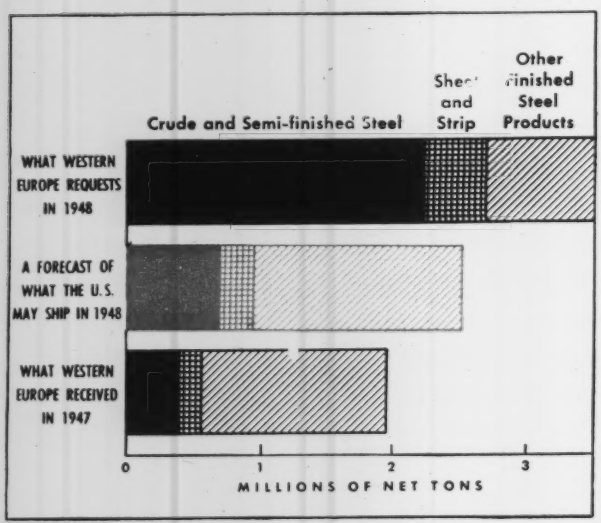
	1948	1949	1950	1951	Total
Ingots and semi-finished items	2,244	2,299	2,475	2,387	9,405
Sheet and strip	424	198	34	...	656
Tin plate	320	314	296	275	1,205
Other finished steel	500	...	...	...	500
TOTAL	3,488	2,811	2,805	2,662	11,766
Steel scrap	1,500	2,000	2,300	2,500	8,300

At first glance these requirements don't appear too hard to meet. This year we have been sending steel abroad at the rate of 6.2 million tons annually. Canada and Latin America took more than 3.5 million tons of this. Europe took only about 2 million tons. Apparently the problem could be solved by shifting exports.

Unfortunately, the answer is not as simple as this. What Western Europe wants – it's really Britain and Italy that want it – are steel ingots and other semi-finished items (billets, blooms, etc.). These the U. S. has been consuming itself. Exports have been almost entirely in the form of finished products.

From the standpoint of the steel industry, shipment of semi-finished items has two bad results. Certain finishing capacity would be made idle. As a matter of fact, the amount of semi-finished steel Western Europe wants is 40% of the supply non-integrated producers of steel products have been able to get from the integrated producers (who turn out the ingots). In addition, badly needed scrap from the finishing process would be lost.

The Dilemma in Steel



What we shall do about this hadn't been settled yet. Those of the President's Advisory Committee on Foreign Aid who specifically studied the question felt very little semi-finished steel should go abroad. This, however, would hit Western Europe hard. A likely compromise – and one suggested by the Government agencies reviewing Western Europe's requirements – would substitute finished items for semi-finished. Shipments of the latter in 1948 would be held to around 650,000 tons, less than a third of the initial request. But export of finished steel (other than sheets or tin plate) would jump to 1,150,000 tons. On one matter, however, all seem agreed. No straight scrap can be sent. The U. S. just doesn't have it.

Where does the steel consumer stand on all this? From his point of view the export of any steel makes life more difficult. No matter what is shipped he will feel it next year. Here is the probable situation under either the initial request or as it may be revised.

a) Overall the supply will remain about as tight as it has been this year. Although demand on the part of equipment producers is expected to decline somewhat, this will be offset by heavier requirements for construction, transport, and export. Late in 1948 and early in 1949, addition of 2.5 million tons of basic ingot capacity may help somewhat.

b) Steel sheets will continue to be a headache, but probably slightly less of a one than in 1947. Long awaited additions to capacity are beginning to come in. By the end of 1948 the total should stand 3 million tons higher than at mid-1947 (a gain of about 18%). Western Europe probably won't get all it has asked for. Shipments might not exceed 225,000 tons, half the initial request. And most of the increase over the export this year (164,000 tons) is likely to come out of shipments that have been going to other areas.

c) Tin plate also seems destined to remain tight. But here the trouble is as much tin as steel. Exports this year are 561,000 tons, but only a fourth has been shipped to Western Europe. If Europe's requirement of 320,000 tons is to be met, other world areas will probably bear much of the burden.

EQUIPMENT BOTTLENECKS – COAL EQUIPMENT

The equipment items are the toughest part of the Marshall program to assess accurately. The European Committee itself failed to develop any clear-cut list of what will be needed. The large sum labeled "mine equipment," for example, includes a certain amount of electrical apparatus. And no detailed breakdown whatsoever was initially presented for the broad equipment groups listed earlier. Some of these shortcomings will be rectified by information now being obtained. In the meantime, equipments lines where the added needs of Western Europe undoubtedly will cause difficulty can be earmarked.

Coal equipment is one such item. The total of $80 million which Western Europe wants in 1948 is half again as much as our export to the entire world this year. Today order backlogs run from 6 to 24 months on many types of mine equipment. Fortunately, some that are most tight – mine locomotives, coal loaders, coal cutters (except the long wall type) – apparently are not wanted by Western Europe in quantity.

Equipment that is needed quickly includes pneumatic tools, conveyor belting, and long wall cutters. These are all adaptable to European mining and can relieve bottlenecks that now exist in supply. Conveyor belting is the most difficult of these items. However, the main trouble in meeting Western Europe's coal equipment needs may arise from another direction – the supply of machinery, parts, and materials for producers of mine equipment in Britain and on the continent. Without help, European plants can't meet the production schedules set for them.

PETROLEUM EQUIPMENT

Western Europe may spend about $130 million on U. S. petroleum equipment next year. This is three-fourths of what was originally planned, but it comes close to our total export of petroleum equipment in 1947. The entire expansion program projected by Western Europe's oil industry will run to some $1.8 billion in four years, with a third for U. S. equipment.

Big items needed probably will include steel pipe and tubes, pumps of many sizes, large vessels (fractionating towers), turbo-generators, and well drilling apparatus and parts. Probably the most difficult problem here is steel tubing. Orders are now on the books for production into 1951. Very little has been exported, and what Europe gets in 1948 will clearly be at the expense of domestic consumers. Other trouble spots are pumps, turbo-generators and large vessels.

Our own petroleum industry is undertaking a record capital outlay on production and refining of about $3 billion this year and next. Part of this is in the Middle East and Western Europe itself. Therefore Western Europe's oil industry will compete with American companies for scarce equipment and supplies. Such competition is to be expected in Europe, as well as here.

Since the American program is much further advanced, Western Europe's expansion plans may well lag. This certainly is likely to be the case in the Middle East. Almost half the U. S. equipment wanted by British and French companies is for projects in that area. Many of these require the help of American engineering firms, since U. S. engineers are most familiar with recent developments in installation and design. This engineering talent is itself a scarce element in the petroleum expansion scheme. It may prove the factor that sets a slower pace than Western Europe had planned.

FREIGHT CARS — DELIVERIES LAG

Freight cars for Germany are the only import of inland transport equipment which Western Europe urgently needs from the U. S. Production within the area can take care of most other requirements.

Import requirements initially were set by the European Committee at 103,000 cars, with 89,000 needed in 1948-49. European equipment is less than half the size of ours; so in terms of U. S. freight cars this boiled down to about 20,000 cars in 1948 and 19,000 in 1949.

Freight cars, of course, are one product whose need in the United States is urgent. Car builders have more than 100,000 cars now on order. Thus far their deliveries have failed to average more than 6,000 cars a month.

The President's Committee on Foreign Aid, surveying the tough situation here and in Germany, finally recommended a shipment in 1948 of 20,000 cars (the American equivalent is 8,000). To the extent this is met, American railroads will have to accept somewhat later delivery. The number involved is not great enough, however, to make any appreciable difference in the overall freight situation. This is likely to remain about as tight in 1948 as it has been this year.

ELECTRICAL EQUIPMENT

Equipment for Europe's electrical industry may prove less troublesome than originally expected. Western Europe plans to produce all the heavy apparatus required for its vast generating plant expansion — at least for the first several years. Thereafter, U. S. producers will be in a position to help them if they need it.

The four year need for U. S. equipment originally was set at $500 million. Some $300 million of this is to be spent on items that do not include any heavy apparatus. Materials and equipment required by the electrical manufacturers themselves are on this list, although no details are given. Its exact effect on our own electrical industry can not be measured until we know more specifically what is involved.

The remaining $200 million will go for hydro equipment on projects of an international character. These may possibly be financed by the World Bank and an immediate start on the equipment is probably not necessary. U. S. electrical equipment producers certainly could not get such work well under way for several years. But certain shipbuilding firms might begin on turbine equipment if desired.

If the electric equipment story ended at this point, it wouldn't be so bad. However, the above figures don't give the full picture. Large motors, turbo generators, and other items are also required for expansion in the petroleum, coal, and steel industries. In many cases these very products have held up the completion of new capacity in this country. Even without Europe's demand they would continue tight well into 1949.

MACHINE TOOLS AND OTHER MACHINERY

Western Europe hasn't set any fixed estimate of what it might spend on machine tools, construction machinery, and other equipment. If the entire program went as initially planned, about $550 million would be available in 1948 for such products. However, the amount actually spent will probably be considerably less than this. No direct aid is likely to be given by the U. S. for the purchase of such equipment; so the countries concerned will have to use whatever funds they can scratch up themselves. How much this will be no one knows.

Machine tools are certain to bulk large on this list. Shipments to Western Europe in first-half 1947 were at an annual rate of $75 million. They should be in larger volume next year. Western Europe appears to hold a fairly adequate stock of general purpose tools. But the expansion of capacity in a number of metal working lines, if carried through, will require a large variety of special purpose tools.

Machine tool needs can be met without difficulty. However, one group of products that might cause trouble is construction equipment. This has been in great demand here. While some items are approaching an easier supply position, others like cranes and power shovels remain very tight. Western Europe has spent a modest sum on U. S. construction equipment — $16 million in the first six months of 1947 — but it would like to spend more. If it tries to do so, exports to Canada and Latin America may have to be cut.

Demand for U. S. textile machinery by Western Europe also has been relatively small — about $7 million in first-half 1947. This situation is expected to continue.

with the region producing most of what it needs itself.

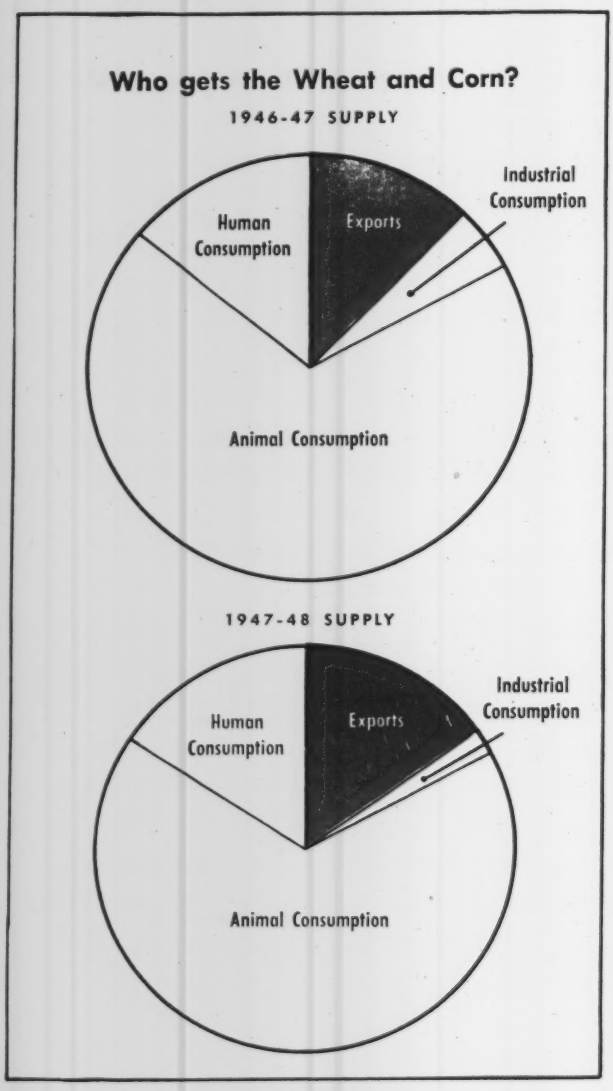
Steam engines, canning machinery, milling machinery, and a long list of other equipment items round out Western Europe's capital requirements. Most of these can be supplied without many of the difficulties reviewed above. And there is one product of great importance to America which Western Europe plans to satisfy largely from its own plants – automotive equipment, particularly passenger cars.

EQUIPMENT FOR THE FARMER

Western Europe's first request for farm equipment in the 1948-51 period was equal to our entire output of 1947. Since this amount obviously can not be spared, the request has been scaled down very substantially. In 1948 shipments are not likely to be more than $100 million, with the new four year goal something on the order of $600 million (half the initial figure).

American farmers can spare this amount of equipment in 1948, although they certainly would buy it themselves if it were not set aside for Europe. Production is likely to run to about $1.35 billion, up some 10% from 1947. But other foreign customers also will have a bid in for a part of this. Canada and Latin America, who bought some $105 million of the $175 million of farm machinery exported this year, need further equipment badly and cannot be shut off with nothing.

After meeting the European and other export demands, American farmers still should receive more new equipment than in any other year except 1947. Thus, they will continue to make considerable progress in their drive to mechanize, although the pace will be slower than they would choose. Above all, the demands of Western Europe and other countries should not be too large to interfere with U. S. food production.



THE FOOD SITUATION

Food may turn out to be one of the chief trouble spots of the Marshall program—particularly for American business. Because of the program, food exports will be larger, domestic consumption somewhat smaller, and prices higher than they otherwise would be. In spite of this, Americans should eat about as well next year as in 1947. However, if prices are bid up in the process, wages and industrial costs may climb with them.

As matters now stand Western Europe would plan to spend about $1 billion on U. S. food in 1948. This is less than they spent in 1947. It also is less than Western Europe feels is necessary to realize the minimum standard of living it set up as a goal for 1948. However, the overall supply of grains – by far the largest commodity on the food list – is down this year by 14%. As a result estimates of Europe's food imports have been reduced.

Here is what went into the record export in the fiscal year 1946-1947. (Figures are thousands of long tons).

	Shipments to Europe 1946-7	Total Exports 1946-7
Wheat and Flour (grain equivalent)	6,638	10,520
Other grains	2,572	4,535
Fats and Oils	156	235
Meat (carcass weight equivalent)	195	224
Dairy Products	322	493
Other Foods	1,266	2,425
Total Foods	11,149	18,435

The President's Committee on Foreign Aid has recommended Europe receive about the same total foodstuffs as last year. However, the product mix will have to be changed. Moreover, the rest of the world will get about a million tons less. Wheat will substitute for corn, but even then the total supply of grains available to Europe will be down 700,000 tons or more. Half of this may be made up with a heavier shipment of fats and oils, including peanuts. Dried milk solids, dried fruits and other products will close the rest of the gap.

There is no doubt the U. S. can send abroad whatever foodstuffs Congress finally agrees upon. The big question is whether this can be done without forcing prices higher. Wheat shipments, for example, may run 40% greater than would normally be exported under current circumstances.

Unfortunately no final answer on food prices is possible. On the supply side much will depend on how next years crops turn out. So far crops are off to a bad start, with winter wheat probably below that of a year ago. As for domestic demand, consumers are likely to have at least as much purchasing power next year as this. The problem is to persuade them to use it on commodities that embody less grain.

When all these considerations are added together it is apparent that food prices over-all do not stand much of a chance to fall markedly in 1948. On the contrary, there is more than a small chance they will rise. Moreover, under the Marshall program exports in 1949-50 would still help support farm and food prices. Any substantial decline could be initiated only by a fall in domestic consumption. Needless to say, these are matters that are important to the business community.

Long Range Problems

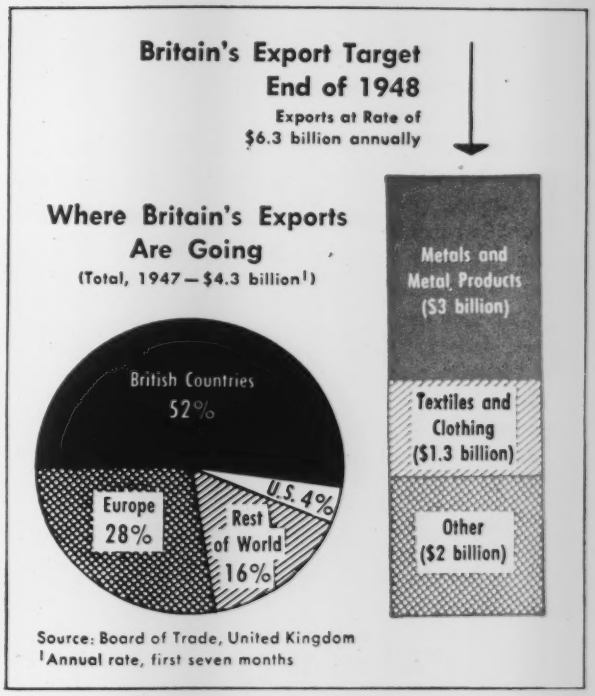
A PROGRAM of the size Western Europe has set for itself inevitably will influence American business over the longer run. New industries are to rise, old ones are to be rebuilt and expanded, exports are to be pushed — all this has a direct bearing on America's foreign markets of tomorrow. Any sound and final judgment concerning the Marshall program, therefore, must weigh certain long run considerations as well as the short.

These longer range considerations are summed up most simply in an assessment of the broad pattern of Europe's future trade. Here a few key trends serve as useful signposts. They are:

a) Industrially Western Europe is preparing to make itself more independent than before the war. This will reduce its imports from the United States. After 1951 export of American manufactures to Europe will be concentrated largely in specialized items which this country has a superior knowledge and skill to produce.

b) Prior to the war Western Europe was primarily an exporter of textiles, industrial products and high quality consumer goods. Industrial revival is along the lines that will push these same products. However, Western Europe's program for expanding industrial capacity points to one significant modification. Capital goods exports — electrical equipment, industrial machinery, finished steel — will bulk much larger than at pre-war.

c) Western Europe's world trade must be considerably larger than in the late thirties. Two developments account for this. First the split in Germany and Europe makes necessary a much larger import of essential foodstuffs and materials from outside the Continent. Second, Europe now must pay for a larger share of its imports with exchange derived from exports. In the Thirties, about one-sixth of Europe's imports represented a return on investments held abroad. While this margin is not eliminated, it has been cut substantially.



d) By far the largest items on Western Europe's import list will be foodstuffs and raw materials. These needs to some extent must govern the location and character of the markets to which it exports. The U. S. must continue to be one such market, for Europe will need our wheat.

A survey of Western Europe's import needs in 1951 shows that Britain and Western Germany are the two countries to whom world trade will be of decisive importance. Other countries will trade as they always have. However, their ability to feed themselves to a large extent lessens their trade burden and makes possible the concentration of much of it within Western Europe itself. It is Britain and Germany, therefore, that are likely to become America's heaviest competitors.

Britain has the world's greatest food deficit. Moreover, its factories are largely engaged in converting the raw materials of other countries into finished goods. Britain therefore must export or die, and that is more true today than ever. The British now have set an export goal that would boost shipments to 175% of their pre-war volume. Later they may pare this. Nevertheless, an export volume at least half again that of pre-war will be necessary for Britain to restore its living standard.

Some clues to what and where Britain will export are available in its current trade pattern (see chart). A close study of this pattern leads to one broad conclusion. The British are concentrating on the export of the same general lines which the U.S. will push. Machinery, automobiles, iron and steel products, electrical goods — these are items that even today stand high on the export lists of both Britain and the United States. Britain in particular must turn to durable goods of this character to replace smaller coal and textile exports.

Prior to the war Britain sought to direct exports primarily to two areas – her empire and Western Europe. Except for foodstuffs from Argentina, British imports from South America were small. This situation has not changed, and there is good reason to believe Britain will seek to maintain it. As the chart shows, about half Britain's postwar exports have been allocated to the Empire, and another quarter to Europe.

Other than in Canada, U. S. firms find it hard to get into this Empire trade. Empire countries have large sterling balances and lack dollars. It is not surprising, then, that they use dollars chiefly for goods Britain can not itself deliver. Such a situation may well last.

The German position is somewhat different, but not radically. Today Western Germany's population of 48 million is almost a fourth greater than in the late thirties. Yet the region can produce little more than half the food it requires. Unlike Britain it must start from scratch in order to develop export markets so as to pay for its food.

Coal will be one money maker for Germany, but it won't earn exchange in all places from which Germany must buy. A likely development is the resumption of shipments of those metal products and chemicals which the Ruhr can produce efficiently and in quantity. Iron and steel products, machinery, chemicals and possibly electrical equipment might be expected to flow from German plants for sale on other continents.

South America, with its food and raw materials, is a natural target for German trade. Such an exchange grew rapidly in the twenties, only to fall victim to the great depression. By the late thirties it was again on the road to revival. The third great push for German-Latin American trade is expected in the fifties.

THE FAR EAST

With Britain enlarging its trade to the Empire and Germany coming into other markets, U. S. traders certainly will feel a competitive pressure that is not present today. How tight that pressure is may hinge on developments in yet another region – the Far East.

The Far East is a vast agricultural and raw material area that has hardly moved to the threshold of industrialization. Yet it has great centers that lend themselves to industrial growth. If political stability were to be established in the Far East, the way would open to a trade greatly benefitting both Europe and the United States, as well as the Far East itself. A surplus of rubber, tin, cotton, wood fibers, and even foodstuffs might then be produced and exchanged for the industrial products of the West.

The Far East, then, is one of the big unknowns in the foreign trade equation of the next decade. Another unknown is the reestablishment of trade between the East and West of Europe. Western Europe's plans count on such trade, and it makes good economic sense. But no one can say for sure that economic sense will prevail in this instance.

These unknowns make any final judgment about the long range success of the Marshall program impossible. This much is certain, however. Without the restoration of East-West trade in Europe, a large expansion of Far East trade becomes an absolute essential. In the absence of both, Western Europe cannot possibly achieve stability by 1952.

Pros and Cons

ANY BALANCE SHEET set up by the business man on the Marshall program will carry a number of items on the liability side. Some of the main entries are these:

The program will be costly – perhaps as much as $15 billion. Through their tax bills business men will bear a good share themselves.

At least for 1948 a number of troublesome bottlenecks will be sustained and even magnified. As a result some producers won't realize the expansion they plan.

The high cost of living, the peg on which many labor troubles hang, will move down very little, if at all, and it may move up.

In helping Europe to reequip itself, American industry is arming a potential competitor. Moreover, the arms it offers are of the most up-to-date variety.

There is no guarantee the program will succeed; as a matter of fact certain conditions essential to its success make it look like a risky bet indeed.

Obviously none of these shortcomings can be taken lightly. Against them, however, can be placed some very weighty items on the asset side.

First, and very important, is the simple but humane consideration that without U. S. aid people in a number of Western European countries will be placed in dire straits. At best they will lack adequate food for a healthy life. At worst they will starve.

The economic situation in Western Europe has a profound political and military meaning for the U. S. This is a matter of direct interest to the businessman. If Western Europe ever loses its political independence to another foreign power, the ultimate cost to America will make the expense of the Marshall Plan look like a mere pittance.

Finally, the Marshall program offers the only hope of realizing some measure of economic stability in a world that today appears permanently upset. In this regard the program can do no harm, but only good. Even if it falls short of its stated objectives, Western Europe will have taken a long stride forward.

The assets outbalance the liabilities.

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UNIT PRICES BID BY CONTRACTORS

Reinforced Concrete Road, Lawrence County, Indiana

OWNER: State Highway Commission, Indianapolis, Indiana; C. E. Vogelsang, Engineer.

PROJECT: Improvement of 2.907 miles of highway in Lawrence County, Indiana, from E. Fork of White River to 16th and M Sts. in Bedford, Indiana. Road to be surfaced with reinforced concrete.

CONDITIONS: Access to job site is available by highway only. All materials are to be furnished by contractor. Stipulated contract time is 250 days from the contract award date. Skilled labor wage rate is $1.05 per hr.; semi-skilled, $0.95 per hr.; and common, $0.90 per hr.

BIDS: Only one bid was received, amounting to $613,196.52, or 2½ percent below the engineer's estimate of $629,078.61. Contract was awarded August 13, 1947 to the bidder, the Calumet Paving Co. of Indianapolis, Indiana.

	Item	Quantity	Unit Prices: Engineer's Estimate	(1)
1	Excavation, common	160,091 cy	$0.43	$0.78
2	Excavation, special borrow	6,310 cy	.55	.78
3	Special borrow, grade "B"	3,708 cy	2.00	2.50
4	Excavation, solid rock	115,226 cy	1.35	.78
5	Overhaul	81,749 cy	.09	.80
6	Added haul	3,897 ea	.06	.60
7	Pavement removal	5,499 sy	.60	.50
8	Salvaged pavement removal	1,044 sy	.65	.70
9	Sidewalk removal	859 sy	.55	.25
10	Retaining wall removal	257 lf	1.00	.25
11	Curb removal	3,277 lf	.45	.25
12	Curb & gutter removal	797 lf	.60	.25
13	Salvaged stone retaining wall removal	252 sy	1.00	.25
14	Guard rail removal	1,941 lf	.50	.25
15	Finishing shoulders & ditches	14,690 lf	.32	.50
16	RC, VC, or Cl pipe—30 in.	364 lf	5.90	6.50
17	RC, VC, Cl or concr. pipe—12 in.	333 lf	2.20	2.00
18	RC, VC, Cl or concr. pipe—15 in.	321 lf	2.40	2.50
19	RC, VC, Cl or concr. pipe—18 in.	189 lf	2.90	3.00
20	RC, VC, Cl or concr. pipe—24 in.	351 lf	4.10	5.00
21	VC, Cl or concr. pipe—24 in.	177 lf	4.10	5.00
22	RC, VC, Cl, concr. or bit. coated CM pipe—12 in.	46 lf	2.20	2.00
23	RC, VC, Cl, concr. or bit. coated CM pipe—18 in.	24 lf	2.90	3.00
24	RC, VC, Cl, concr. or bit. coated CM pipe—30 in.	18 lf	5.90	7.00
25	Sewer pipe—4 in.	100 lf	1.20	1.50
26	Sewer pipe—6 in.	538 lf	1.30	1.50
27	Sewer pipe—8 in.	200 lf	1.45	1.75
28	Sewer pipe—10 in.	200 lf	1.75	2.00
29	Drain tile, vit. clay tile or cmt. concr. tile—6 in.	100 lf	1.20	1.20
30	Drain tile, vit. clay tile or cmt. concr. tile—8 in.	100 lf	1.35	1.40
31	Drain tile, vit. clay tile or cmt. concr. tile—10 in.	100 lf	1.60	1.60
32	Bit. coated CM pipe—12 in.	246 lf	2.45	2.00
33	Bit. coated CM pipe—15 in.	308 lf	2.80	2.50
34	Bit. coated CM pipe—18 in.	38 lf	3.35	3.00
35	Extra strength RC or Cl—30 in.	160 lf	6.95	8.00
36	Standard strength RC or Cl pipe—15 in.	51 lf	2.80	2.50
37	Standard strength RC or Cl pipe—18 in.	168 lf	3.50	3.00
38	RC, VC, Cl. conc. pipe (bell & spigot joints)—12"	1,548 lf	3.60	2.00
39	RC, VC, Cl. conc. pipe (bell & spigot joints)—15"	207 lf	4.00	2.50
40	RC, VC, Cl. conc. pipe (bell & spigot joints)—18"	486 lf	6.50	3.00
41	RC, VC, Cl. conc. pipe (bell & spigot joints)—24"	332 lf	7.75	5.00
42	Bit. coated perf. CM pipe for subsurface drains—6"	90 lf	1.25	1.20
43	Bit. coated perf. CM, VC sewer, cmt. concr. sewer of perf. VC sewer pipe for subsurface drains—6 in.	510 lf	1.25	1.20
44	Aggregate for subsurface drains	90 cy	4.00	5.00
45	Catch basins, type A-3	14 ea	210.00	250.00
46	Catch basins, type A-2	1 ea	190.00	250.00
47	Catch basins, type C-5	1 ea	135.00	250.00
48	Catch basins, type C-5 (with hood)	1 ea	160.00	300.00
49	Pipe catch basins—18 in.	2 ea	60.00	100.00
50	Inlets, type A-3	7 ea	100.00	125.00
51	Inlets, type C-5	1 ea	85.00	125.00
52	Manholes, type A-4	1 ea	250.00	250.00
53	Manholes, type B-4	11 ea	230.00	250.00
54	Type "4" casting & adjust to grade	7 ea	80.00	25.00
55	Spring box	1 ea	75.00	125.00
56	Concr. for structures class "D"	925.6 cy	47.00	50.00
57	Concr. for structures special class "D"	89.7 cy	60.00	60.00
58	Reinforcing steel for structures	274,955 lb	.09	.09
59	Reinforced concr. pavement	51,784 sy	3.02	2.95
60	Private drive pavement	415 sy	3.60	3.20
61	Reinforcing steel for pavement	1,112 lb	.09	.10
62	Traffic lane stripe—6 in.	2.883 mi	350.00	400.00
63	Intermittent traffic lane stripe—4 in.	0.514 mi	325.00	400.00
64	Concr. header	14 lf	2.75	3.00
65	Grade "C" spl. borrow for subgrade treatment	12,608 cy	1.75	2.00
66	Expan. joint 1" cork, rubber or fiber	153 lf	.65	0.50
67	Expan. joint 1" preformed with load transfer	211 lf	.90	.90
68	Expan. joint 1" preformed	402 lf	.65	.50
69	Expan. joint ½" preformed	174 lf	.60	.50
70	Contraction joints, type D1, D4, D5	11,942 lf	.60	.75
71	Bit. stabilized mixture, type "A"	1,344 tons	8.00	7.00
72	Bit. stabilized mixture, type "B"	1,294 tons	7.75	7.00
73	Aggregate for compacted aggregate surface	800 tons	3.75	3.50
74	Furnishing seed & fertilizer for plain seeding	4.08 ac	40.00	40.00
75	Plain seeding	4.08 ac	35.00	40.00
76	Mulched seeding	111,974 sy	.09	.08
77	Sodding	14,272 sy	.40	.30
78	Sodding shoulders	15,376 sy	.38	.30
79	Flexible steel plate guard rail	152 lf	2.50	3.00
80	Guide posts, type "A"	73 ea	2.75	3.00
81	Barricades, type "A"	2 ea	70.00	25.00
82	Barricades, type "B"	6 ea	60.00	75.00
83	Prewarning signs	8 ea	50.00	60.00
84	Signs, X 10-R	2 ea	60.00	60.00
85	Signs, X-13	12 ea	50.00	60.00
86	Paved side ditch type "A"	3,289 lf	1.75	1.50
87	Paved side ditch, type "B"	481 lf	2.25	2.00
88	Paved side ditch, type "C"	330 lf	2.60	2.50
89	Paved side ditch type "D"	537 lf	2.80	3.00
90	Paved side ditch, type "E"	338 lf	3.85	3.50
91	Paved side ditch, type "G"	920 lf	4.85	5.00
92	Integral concr. curb	5,616 lf	1.50	1.40
93	Riprap	660 sy	4.50	4.00
94	Salvaged stone riprap	50 sy	3.50	4.00
95	Bench mark post	1 ea	20.00	25.00
96	Sidewalk	498 sy	3.25	2.00
97	Crosswalk class "B"	9 sy	3.60	3.00
98	Maintaining traffic	lump sum	1,500.00	1,000.00

Sanitary Sewer and Water Main Extensions, McKenzie, Tenn.

OWNER: City of McKenzie, Tenn.; W. W. Turner Co., engrs.

PROJECT: Project includes excavation, backfill, cleanup and installation of 6" cast iron water pipe, cast iron gate valve, fire hydrants, 8" clay sewer pipe—standard and extra strength, 6" clay sewer pipe, 8" cast iron sewer pipe and standard brick manholes; furnishing and installing sewage ejector, expelsor (complete in place), including piping, controls, compressor, but not including concrete pit.

CONDITIONS: All materials, tools, equipment and superintendency of labor are to be furnished by the contractor. Stipulated contract time is 240 calendar days.

BIDS: Three bids were received, ranging from the contract low of $70,219.00 to $75,669.29. Contract was awarded September 30, 1947.

LIST OF BIDDERS:

1. Volz Const. Co., Ripley, Tenn. $70,219.00
2. Bush Building Co., Nashville, Tenn. 74,499.85
3. Gregory-Barr 75,669.29

	Item	Quantity	Unit Prices: (1)	(2)	(3)
1	Cast iron pipe	18,137 lf	$2.25	$2.25	$2.30
2	Cast iron fittings	13,251 lb	.13	.18	.18
3	Cast iron fittings	1,566 lb	.12	.12	.11
4	Cast iron gate valve—6"	24 ea	50.00	65.00	60.00
5	2-Way fire hydrant	31 ea	110.00	125.00	120.00
6	3-Way fire hydrant	2 ea	130.00	140.00	130.00
7	Vit. clay pipe, 0 to 6'—8" dia.	438 lf	2.25	2.50	2.25
8	Vit. clay pipe, 0 to 6'—8" dia.	940 lf	1.85	2.00	1.95
9	Vit. clay pipe, 6' to 8'—8" dia.	202 lf	2.00	2.30	2.35
10	Vit. clay pipe, 8' to 10'—8" dia.	193 lf	2.50	2.75	2.85
11	Vit. clay pipe, 10' to 12'—8" dia.	307 lf	3.00	3.25	3.80
12	Vit. clay pipe, 12' to 14'—8" dia.	709 lf	4.00	4.00	5.10
13	Vit. clay pipe, 14' to 16'—8" dia.	351 lf	5.00	6.00	7.00
14	Vit. clay pipe, 16' to 18'—8" dia.	45 lf	6.00	8.00	10.00
15	"Y" branch—8"	6 ea	2.00	3.00	4.00
16	30 degree curve—8"	6 ea	2.00	3.00	3.00
17	Vit. clay pipe, 0 to 6'—6" dia.	100 lf	1.60	1.50	1.75
18	8" Barrel x 6" Y branch	8 ea	2.00	3.00	3.50
19	Short radius curve—6"	8 ea	2.00	3.00	2.00
20	Vit. clay pipe, 0 to 6'—8" dia.	288 lf	3.35	3.50	3.75
21	Brick manhole, 0 to 6'	4 ea	130.00	135.00	140.00
22	Brick manhole, 6' to 8'	1 ea	170.00	155.00	170.00
23	Brick manhole, 10' to 12'	3 ea	250.00	190.00	230.00
24	Brick manhole, 12' to 14'	3 ea	290.00	210.00	260.00
25	Brick manhole, 14' to 16'	1 ea	320.00	300.00	290.00
26	Brick manhole, 16' to 18'	1 ea	360.00	350.00	340.00
27	Drop brick manhole, 8' to 10'	2 ea	250.00	200.00	230.00
28	Sewage ejector & piping	lump sum	2,400.00	3,000.00	2,500.00
29	Chert	1,000 cy	2.50	3.00	4.00
30	Class "A" concrete	37.2 cy	75.00	75.00	65.00
31	Reinforcing steel	5,564 lb	.10	.10	.10
32	Culvert excavation	160 cy	2.00	10.00	2.50

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bringing *power lubrication* to a large dirt mover out on the job—just one of many ways that Alemite helps the construction industry cut costs.

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MANUFACTURERS' LATEST DEVELOPMENTS IN EQUIPMENT AND MATERIALS

(Number refers to item directly below it)

48

CONCRETE BLOCK FORK—Need of pallets is eliminated by a new completely automatic concrete block fork, which can be attached to any lift truck. Prongs are steel plate individually bolted to lower part of protecting structure and easily removed. In each

is housed rubber gripping mechanism, which is actuated when load is prong lifted and comes in contact with prong. Fork will handle standard 4. 6, 8 and 12-in. blocks. Capacity of fork is limited only by capacity of lift truck on which it is used.—*Schmidgall Mfg. Co., 337 Cass St., Peoria 2, Ill.*

49

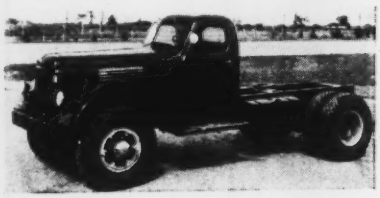
LOCOMOTIVE CRANE—A diesel-locomotive crane capable of travel speeds up to 15 mph. and ruggedly built to perform heavy-duty switching operations as well as handle a wide variety of heavy loads, is offered in capacities ranging upwards from 30 tons. The diesel-electric combination permits the power to be transmitted directly to the axles by inside hung spring-suspended motors. An important design feature of the Brownhoist locomotive crane is the patented Monitor-type cab that affords the operator unrestricted visibility in every direction—360 deg. Electric swing is available at additional cost.—*Industrial Brownhoist Corp., Bay City, Mich.*

50

TRUCK TIRES—Two new sizes of truck tires are 7.50-20 ten-ply Universal, and the 14.00-24 twenty-ply Rock Quarry casing. The Universal tire is widely used in quarry and gravel pits, and the Rock Quarry casing has a smooth tread, specially designed for quarry operators and various mining uses where cutting has been a problem.—*The B. F. Goodrich Co., Akron, Ohio.*

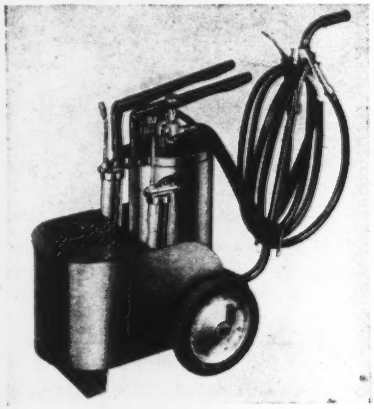
51

OFF-HIGHWAY TRUCK—New four-wheel heavy-duty Model KBR-14 has gross vehicle weight rating range of 32,000 to 41,600 lb. and is specially designed for use in strip mining, logging, construction, oil field, quarry and similar off-highway types of service as truck-tractor or straight truck. It is available in three wheelbases, 161, 179 and 215 in. with cab-to-axle dimensions of 72, 90 and 126 in., respectively, and is powered by six-cylinder International-Continental R-6586 valve-in-head engine. Maximum brake horsepower is 200 at 2,600 rpm., with maximum torque of 475 ft.-lb. at 1,000 rpm.—*International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill.*



52

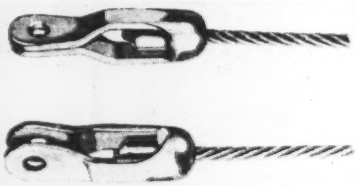
LUBRICATING UNIT—New lube service cart is complete lubricating department on wheels, which needs no air or electric connections. It carries generous supply of three lubricants, two greases and one oil. Two 1-lb.



lever guns and one ½-pt. pistol oiler are included. Pressure lube pump has built-in gun loader for hand guns. Front section of cart incorporates large tool box.—*Gray Co., Inc., Graco Square, Minneapolis 13, Minn.*

53

CABLE TERMINALS—"Socketype" cable terminals consist of an alloy steel cadmium plated eye or fork type fitting, plus a stainless steel sleeve for swaging to cable (wire rope). They are available loose or attached to the rope in a complete cable assembly to specification length. It is



said that these terminals save cable, allow the cable to swivel freely when load-free which eliminates kinking.

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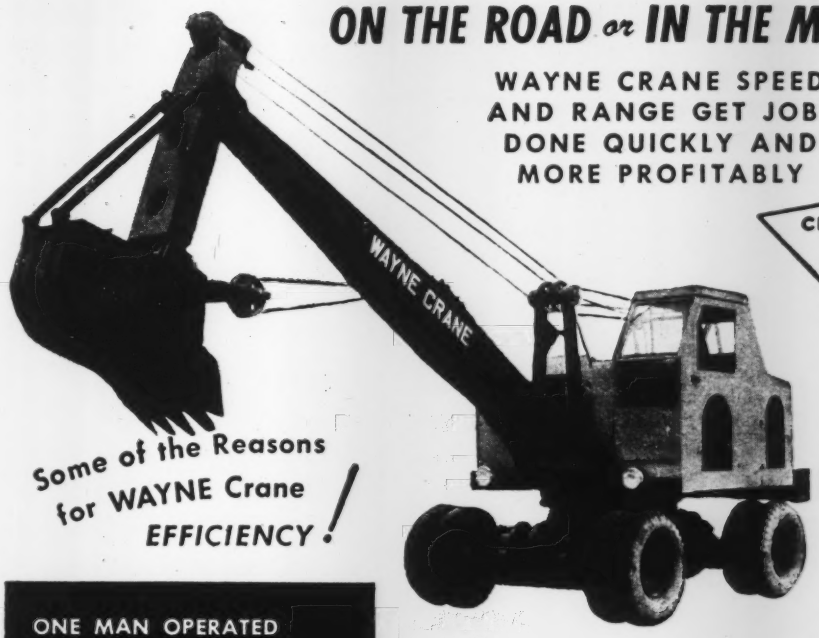

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CHANGES TO ANY ATTACHMENT IN AN HOUR OR LESS

Some of the Reasons for WAYNE Crane EFFICIENCY!

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- SINGLE ENGINE POWERED
- FOUR-WHEEL DRIVE
- HYDRAULIC STEERING
- LEVELIZING CHASSIS
- NO CENTER PIN
- OIL IMMERSED GEARS
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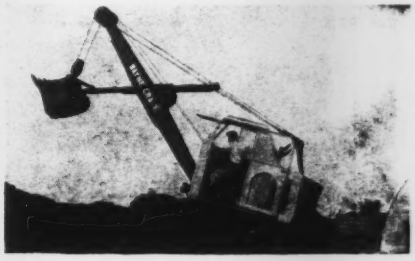
- 30% LARGER DRUMS
- WORM DRIVEN BOOM HOIST
- 22′ TURNING RADIUS
- TWO BOOMS SERVE ALL FIVE ATTACHMENTS

. . . AS A TRENCH HOE ONE MAN OPERATED . . . . . .

Easy to operate with 5½ R.P.M. swing speed. Wayne Crane handles more material and is completely mobile on 4-wheel drive, dual tired wheels. Rising labor costs make one man operation one of Wayne Crane's most desirable features. The full-vision, safety glass, weather-proof cab protects the operator.



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They provide a safe, smooth, foul-free installation.—*Macwhyte Wire Rope Co., Kenosha, Wis.*

54

ELECTRICALLY POWERED CRANE—New 15-ton Tournacrane is powered by three electric motors fed by high-capacity generator mounted in line with engine. All operations are handled through finger-tip control. Boom is raised or lowered in boom track supported by rear axle. Boom track may be tilted from its normally vertical position. Therefore, reach of boom can be adjusted regardless of its vertical position, which is independently controlled. This gives unit long reach and great maneuverability. New unit with C-10 Tournapull has maximum height of lift of approximately 30 ft. and maximum reach of approximately 26 ft. behind rear axle. Lift can easily be increased 16 ft. more by addition of simple boom extension. Loaded or empty, crane will travel 20 mph.; crane and Tournapull weight about 28,500 lb.—*R. G. LeTourneau, Inc., Peoria, Ill.*

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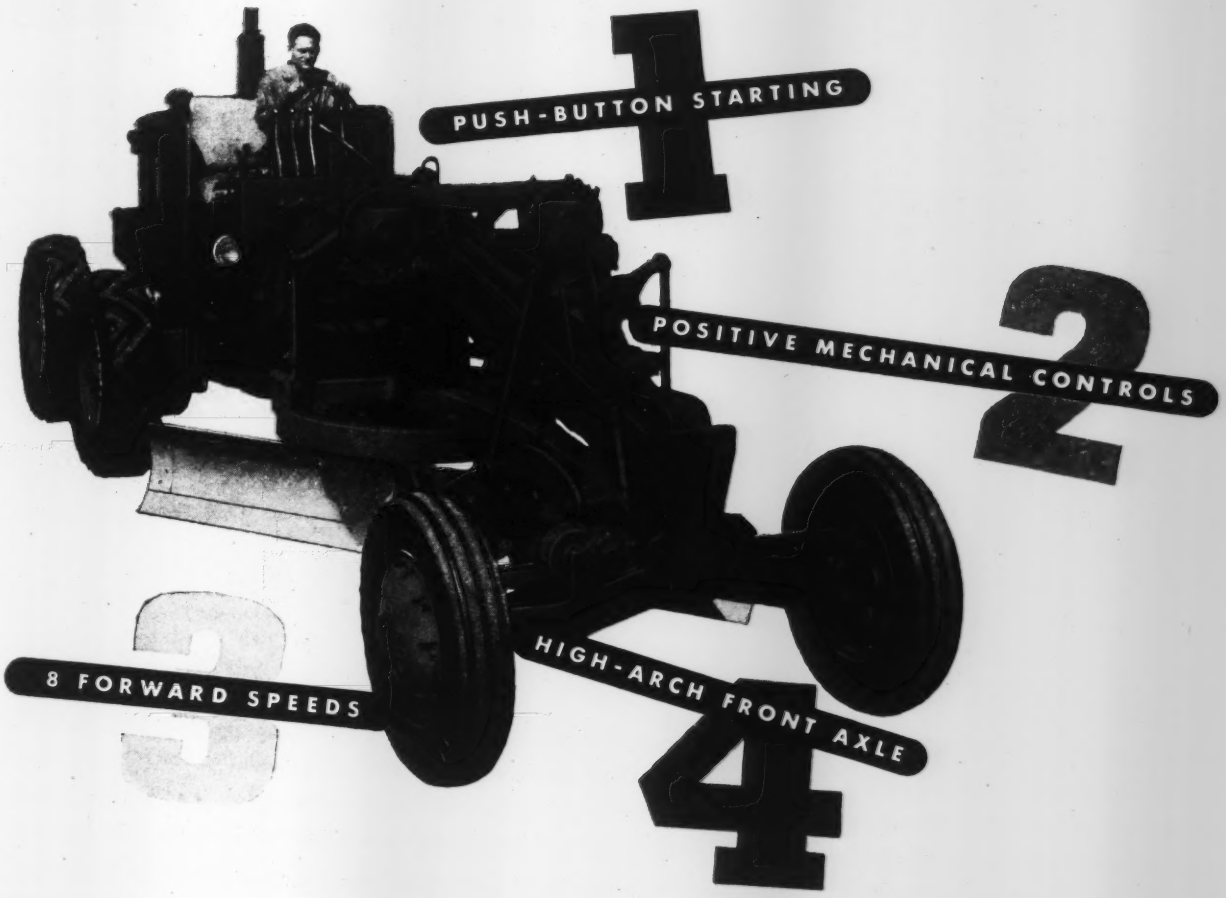

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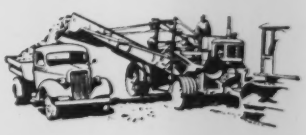

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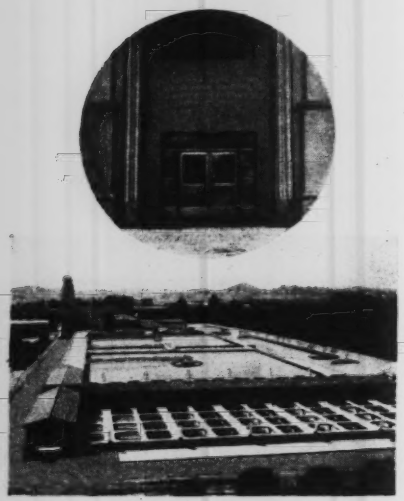

The Metropolitan Water District of Southern California in doubling the capacity of its water softening and filtration plant at LaVerne, California, opens its doors again to Builders Equipment. The new 100 m.g.d. addition, like the original plant, will have Builders Gauges, Controllers, Diaphragm Pendulum Units, and Master Controls.

Bringing water from the Colorado River and distributing it to the district member cities has been one of the world's great engineering accomplishments. It is a tribute to the performance of the original equipment on this great project that Builders Equipment is again specified . . . no better recognition of quality and dependability could be awarded any product. Through the years an ever-increasing volume of repeat business has come to Builders from satisfied customers.

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24 Model RCB Rate Controllers, 20" and 24"
24 Diaphragm Pendulum Pilot Valve Units
24 Recording Gauges with strip charts
12 Loss of Head Air Operated Transmitters
24 Rate of Flow Air Operated Transmitters
2 Master Controls (grouped in sixes)
1 Twelve-Unit Air Summator
1 Special Summation Unit

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BUILDERS—PROVIDENCE *Instruments*

Manufacturers' Publications

55

Concrete Improver — (4-p. folder) Describes Portite, easy-to-use liquid which, when added to mix, is said to provide greatly improved concrete, plaster and lime-free mortar. It is also said to reduce shrinkage, with less need for expansion joints, and to eliminate segregation and dusting. — *Hopper Products, Inc., 12 E. 41st St., New York 17, N. Y.*

56

Buildings of Aluminum and Steel— (Three 8-p. booklets) Describe and illustrate homes and industrial buildings constructed of insulated aluminum or steel panels. — *Butler Mfg. Co., Kansas City, Mo.*

57

Rubber Footwear — (4-p. catalog section) Describes construction of boots, rubbers, gaiters, work shoes and pacs and outlines their particular functions in industry.—*B. F. Goodrich Co., Akron, Ohio.*

58

Preservative-Treated Lumber —(4-p. folder) Covers usage and specification of "Wolmanized" lumber and "Minalith" fire-retardant lumber, giving details of properties and characteristics of forest products alloyed with Wolman and Minalith salts. — *American Lumber & Treating Co., 332 S. Michigan Ave., Chicago 4, Ill.*

59

Overhead Trolley — (8-p. folder) Describes engineered trolley for overhead conveyors, giving dimensions, weights, trolley ratings, allowable chain pulls and other data for selection of proper trolley for service.—*Link-Belt Co., 307 N. Michigan Ave., Chicago 1, Ill.*

60

Slurry Pump—(16-p. bulletin) Demonstrates outstanding mechanical features of new slurry pump, whose wear parts are centrifugally cast of abrasion resistant diamond alloy. Complete engineering and pumping data, selection chart, dimensions, assembly drawings and parts list are included.—*Pettibone Mulliken Corp., 4710 W. Division St., Chicago 51, Ill.*

61

Snow Clearing — (8-p. booklet) Shows diesel tractors and motor graders at work with V-type and one-way snow plows, snow wings and tractor-mounted loaders opening the way for ground and air transportation in city and rural communities.—*Caterpillar Tractor Co., Peoria, Ill.*

62

Underpasses and Service Tunnels—(24-p. manual) Tells how to provide underground passageways for people, livestock, merchandise or utility lines. It provides pictures and data on sizes and shapes of openings and describes available metal structures. — *Armco Drainage & Metal Products, Inc., Middletown, Ohio.*

63

Tool Steel — (72-p. catalog) Lists tool and high speed steel warehouse stocks, indicating types, shapes and sizes available, and showing exact location of each item in stock.—*Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa.*

64

Cast Iron Water Mains—(20-p. brochure) Contains factual data reprinted from study of "Survival and Retirement Experience with Water Works Facilities" prepared by joint committee of American Water Works Association, New England Water Works Association and Institute of Water Supply Utilities. It covers records of 23 water works properties in United States and two in Canada.—*Cast Iron Pipe Research Association, Chicago 3, Ill.*

65

Rotary Drills — (One-page bulletin) Describes concrete Termite rotary drill, which depends on new patented rotary pulverizing action rather than sharp cutting edges or hammerlike blows to drill straight, clean, true holes through any masonry-like material. Termites can be used with any electric drill.—*Lott Sales Co., 2301 Main St., Santa Monica, Calif.*

66

Cement Waterproofing — (12-p. booklet) Shows how basements, tunnels, dams, tanks, silos and concrete roofs can be kept "bone dry".—*Ranetite Mfg. Co., Inc., 1917 S. Broadway, Saint Louis 4, Mo.*

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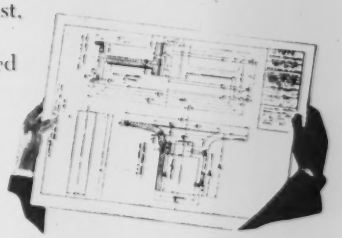

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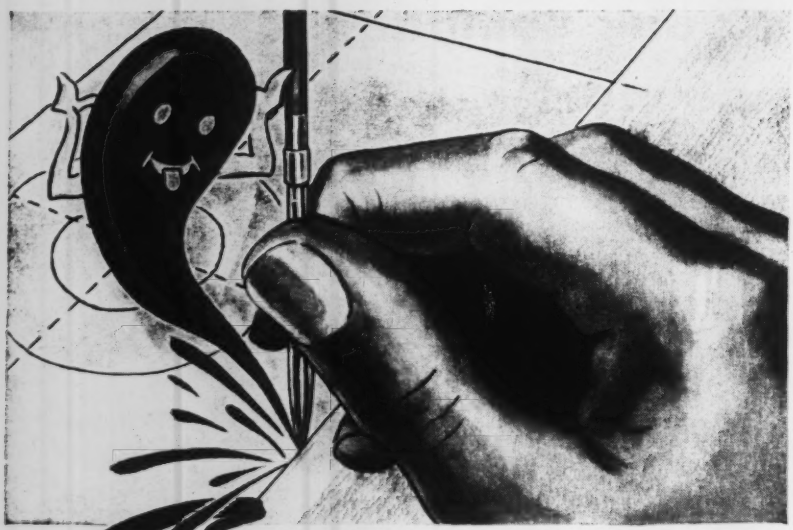

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5 *No pinholes or thick threads*
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Men and Jobs

Lewis Dodson, formerly director of public health practices, National Sanitation Foundation, Ann Arbor, Mich., has been appointed director of environmental sanitation, City and County Health Department, Denver Colo. At present he is engaged in developing a new refuse disposal program for the city of Denver involving the use of sanitary fill.

H. P. Cortelyou, director of the bureau of maintenance and sanitation of the Los Angeles, Calif., city department of public works, retired Oct. 31. He had been in city service for 36 years, rising from draftsman to engineer-director in 1941, and has directed work of more than 2,300 employees. He is a brother of S. V. Cortelyou, district engineer of the California state division of highways.

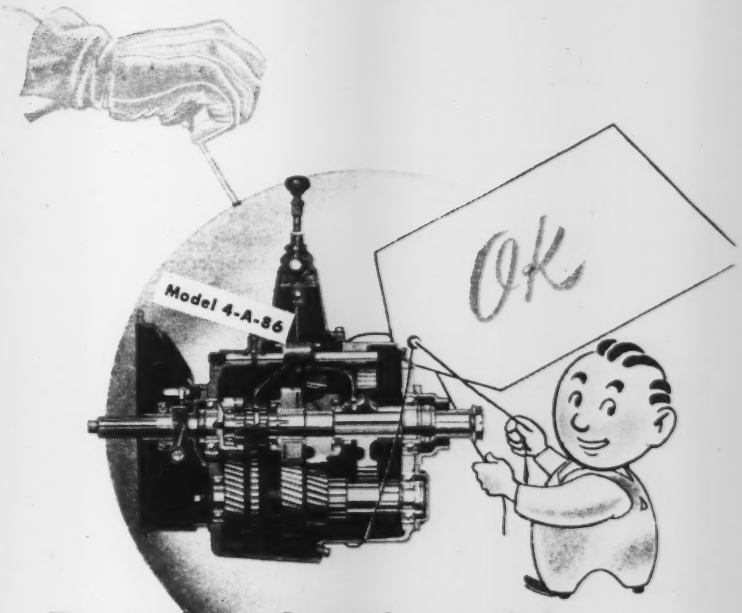
Col. Louis H. Foote, formerly executive officer of the Ohio River Division, Corps of Engineers, in Cincinnati, Ohio, has succeeded Col. Edwin P. Lock as district engineer, Memphis District. Born in Tishomingo, Okla., in 1904, Colonel Foote attended Washington State College, where he was a member of the Reserve Officers' unit. Upon his graduation there in 1927, he was commissioned a second lieutenant in the Corps of Engineers and assigned to the 6th Engineers, then at Fort Lewis, Wash. He was graduated from the Engineer School, Fort Belvoir, Va., in 1931. In 1936 he served with the Corps of Engineers in the construction of Conchas Dam in New Mexico. He has had considerable service with troops, having served with the 813th Engineer Aviation Battalion in the Alaskan Command in 1942 and, subsequently, with the 51st combat Battalion in the same command.

Elections and Activities

W. M. Franklin of Charlotte, N. C., has been elected chairman of the North Carolina Section of the American Water Works Association and the North Carolina Sewage Works Association. He served as vice-chairman during the year just ended and succeeds J. A. English of Salisbury. Other officers elected are: R. W. Luther of Elizabeth City, vice-chairman; George S. Moore of Albemarle, renamed secretary and treasurer; H. F. Davis of Charlotte, trustee; and W. W. Adkins of Asheboro, chairman of the membership committee.

Speakers heard at the recent annual meeting of these two organizations and their topics included: Waldo G. Bowman, of New York, editor of *Engineering News-Record* and *Construction Methods*, an illustrated talk on "Reconstruction in Europe;" Linn H. Enslow, vice-president of the American Water Works Association; Robert C. Gloppen, sanitary engineer with Yeomans Brothers Company of Chicago, "Discussions of High Rate Trickling Filters;" Harry E. Schlenz, vice-president and sales manager of Pacific Flush Tank Co., Chicago, "Sludge Digestion;" Charles Bachman, of the Neptune Meter Co., New York City, "Selection and Care of Water Meters;" A. B. Anderson, chief engineer of water and sewage division, Pittsburgh Pipe Cleaner Co., "The Pittsburgh Eric Method of Coating Water Pipe in Place;" K. K. Kirawn, Jr., of Centraline Corp., New York City, "Development and Application of the Centraline Process of Cement Lining Water Mains in Place". G. F. Catlett and Dr. Zachary Stadt discussed the use of fluorine in municipal water supplies.

At a meeting of the newly formed New England Section of the Institute of Traffic Engineers held in New Haven, Conn., the following officers were elected: Earl W. Osterhoudt, traffic engineer, Connecticut State Highway Department, president; William E. Billings, director, Bureau of Traffic Safety, Liberty Mutual Insurance Co., Boston, Mass., vice-president; Charles S. LeCraw, Jr., resident traffic engineer of the Eno Foundation, Westport, Conn., secretary-treasurer. The new section is one of four approved by the board of direction of the institute which was organized in 1931. With headquarters at Yale University, membership is now approximately 400. The institute's president is Robert A. Mitchell, chief, Bureau of Traffic Engineering, Philadelphia. Pa.



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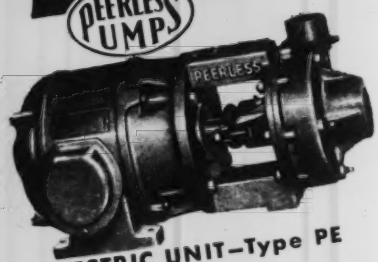

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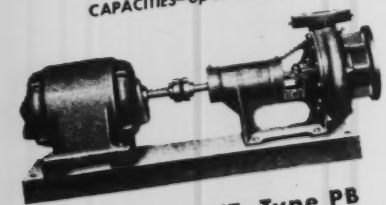

BELT DRIVEN UNIT—Type PB

Steel shaft, turning in grease lubricated ball bearings is built to receive either V or flat belt pulley; or may be direct-connected as shown to standard stock horizontal motor through flexible coupling.

THE FLUIDYNE MOVES WATER AND OTHER LIQUIDS WHERE YOU WANT THEM. The Peerless Fluidyne is ideally applied to a host of commercial and industrial uses. A natural for system pump sub-assemblies. Handles water as well as slightly viscous or alkaline liquids. Operates in any position.

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Manufacturers' Activities

Four divisional managers of NORDBERG MANUFACTURING CO., Milwaukee 7, Wis., have been promoted to vice-presidencies: Roland W. Bayerlein, heavy machinery; H. H. Talboys, railway equipment; D. A. Cheyette, crusher; and R. R. Shafter, process machinery.

THE BUDA CO., Harvey, Ill., announces the appointment of Harry G. Campbell as sales manager of the DieseLight division, handling sales and manufacture of diesel electric and gasoline electric generator sets.

C. W. WHEATLEY of the manufacturing division of the A. O. Smith Co., Milwaukee, has been named general manager of the firm's Houston plant to succeed Ben F. Bart, who will become executive administrator of the Smith southwest district, which includes eight states.

T. O. LIEBSCHER, secretary-treasurer of the Le Roi Co., Milwaukee, has been elected to a new position of executive vice president and Thomas S. Tuttle, former assistant secretary-treasurer has been appointed secretary-treasurer.

WILLIAM R. HOLMES, who has been with the Milwaukee sales office since 1942, has been appointed assistant district manager for its Newark branch by the United States Steel Supply Co., subsidiary of the United States Steel Co.

Appointment of EDGAR J. REICHENBACH as manager, specialties and machinery division of the general sales department of the United States Steel Supply Co. has been announced. He will make his headquarters at 1310 Wabansia Ave., Chicago, Ill.

A. F. BOUCHER, welding engineer for The Lincoln Electric Co., handling special accounts in the Detroit area, has become district manager for the Milwaukee office at 733 N. Van Buren St. Marshall Ford has been made district manager for the company's Minneapolis office at 529 So. 7th St.

Appointment of I. L. PIERCE as director of the Ford Motor Co. service department has been announced. The service department formerly was operated in conjunction with Ford parts and accessory sales, but the two will be separated, both remaining under the jurisdiction of the sales department. A. B. Pease will continue to direct parts and accessory sales. R. W. Hickl will manage auto accessory sales activities, and Arthur W. Kelley will manage accounting for parts and accessory sales under M. E. Sheppard, general assistant controller.

FRANK A. YOUNG, a representative in Allis-Chalmers. Duluth, Minn., branch office since 1944, has been named manager of the office.

Appointment of ELMER KYNDBERG to the general sales managership of Cyclone Fence Division of American Steel & Wire Co., U. S. Steel subsidiary at Waukegan, Ill., has been announced. Three other appointments are: Joseph F. Boyce, district sales manager of Waukegan district; Robert W. Ewert, district sales manager of the Southeastern district, Savannah; John D. Filer, assistant district sales manager of the Eastern district, Newark, N. J.

Appointment is announced of FRANKLIN M. (MAC) MCCORKEL as a district manager of the New Holland Manufacturing Co., Mountville, Pa., makers of crushing and screening equipment.

HUGH L. BAKER has been appointed general sales manager of the Mueller Co., Decatur, Ill. J. W. Simpson, vice-president in charge of sales, will continue in an advisory capacity, and will spend considerable time working with the company's engineering department on new products in the sanitary field. Robert K. Levey will handle promotional and sales personnel work.

METAL & THERMIT CORP. announces the appointment of O. L. Howland as sales manager of its welding division, 7300 So. Chicago Ave., Chicago, Ill. Wm. C. Cuntz has been made assistant sales manager of the corporation's welding division, Pittsburgh.

B. H. JOHNS, for the past seven years manager of the St. Louis branch of Independent Pneumatic Tool Co., manufacturers of Thor portable power tools, has been appointed manager of the company's mining and contractors tool sales division, at Chicago. W. B. Smith, former manager of the Houston branch will succeed Mr. Johns, and R. F. Caslin, former electric tool service engineer in Houston has been appointed to succeed Mr. Smith.